#31585 4-GAS TEST CALIBRATION KIT

INCLUDES:

① TANK LO-GAS
① REG. KIT
① FLOW RESTRICTOR & VALVE (41581-1 RESTRICTOR)
① FLOW GUAGE
② RS 232 CONNECTORS (2-TYPES)
① MONITOR CABLE

DIANA BROWN — WARR. ADM.
LAURIE BACLICH — DISPATCHER (CLOSE TO STEVE J.)
JILL BARENSVILLE — " (BLOND HAIR)
SUE ISRAEL — " (SMALL DARK HAIR)

JILL PAULSON — WORR ORDERS & CORES (SERIOUS)
TERRI SIMONOVIC — PARTS (IN CORNER)
LAURI BOLBY — LITERATE & WARR FORMS (TALL)

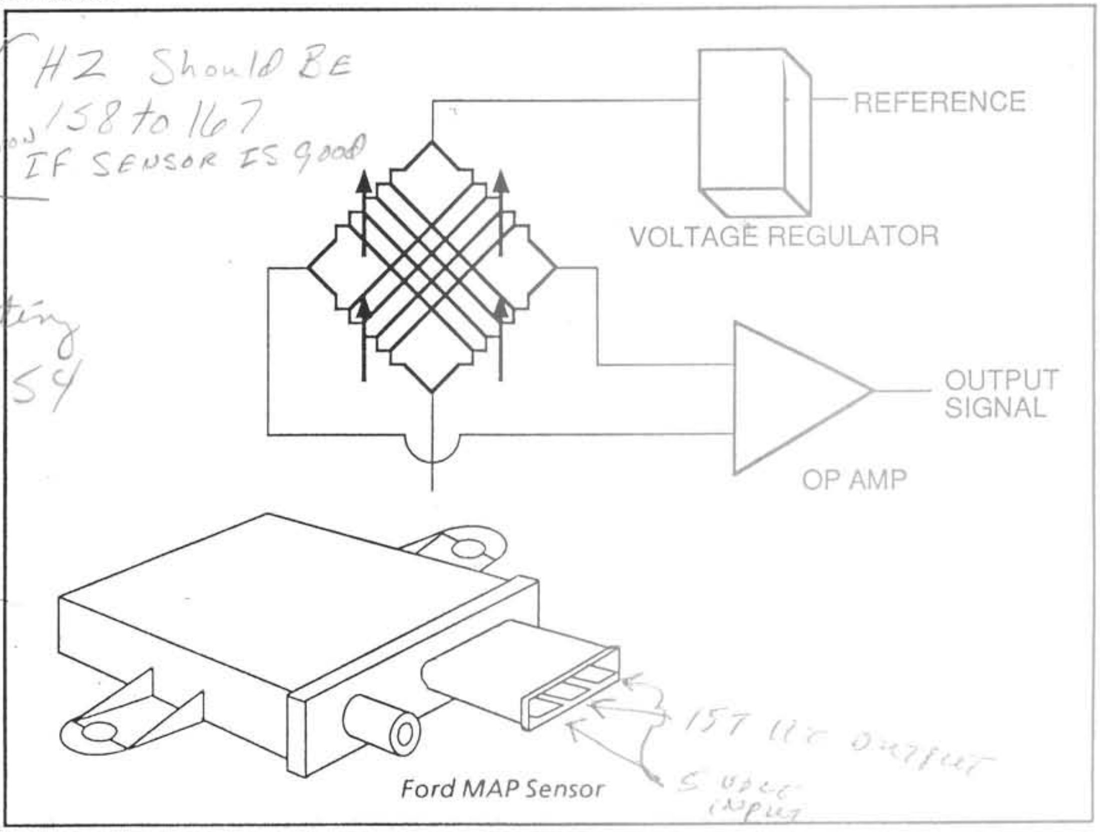
The MAP sensor used by Ford and Mazda vehicles since 1983 is different.

This sensor converts the output from the crystal to a frequency and then sends it to the computer.

Ford MAP
ON Fuel INjection

HZ Should BE
158 to 167
IF SENSOR IS good

always getting
HZ of. 154



Ford MAP Sensor

157 Hz output

5 volt input

The frequency range of the Ford MAP sensor is 92-162 cycles per second (Hz).

~~JOHNSON FORD~~

SLAOSE

ROCK MACHINE
& PATTERN TEARS
300 ON OXYGEN
425 MIN WARM
CHECK POWER

The *MAP* sensor affects the Air Fuel Ratio and timing. In some applications the MAP sensor is only used as a Barometric pressure sensor. On these applications the sensor frequency range is from 122-162 Hz, the range of normal atmospheric pressure.

The *barometric* pressure sensor alone performs altitude correction for:

- Air fuel ratio
- EGR flow for altitude compensation.

Testing this sensor with a voltmeter will result in an *average* voltage reading, which will be inaccurate. Use an oscilloscope for fast accurate sensor diagnosis.

FIRE

Symptoms

STOP FI! PUT IN FORD IN MATTS DEMO

A faulty MAP sensor may cause:

- Rich mixture
- Incorrect ignition timing
- Engine ping
- Intermittent stalls
- Stumble on acceleration

Test Procedure

1) Use the following selections when testing a MAP sensor with an oscilloscope.

SOURCE: Blue lead
TRIGGER: Internal
ADJUST: 200 Hz Sweep rate
GAIN: X 1
OFFSET: 0

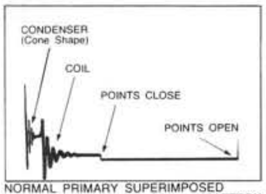
PRANTE BUICK
WATERTOWN

ALEK AUTI

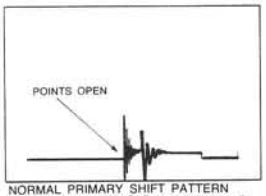
2) Connect the Blue lead to the sensor signal terminal.

SCOPE PATTERN DIAGNOSIS CHART

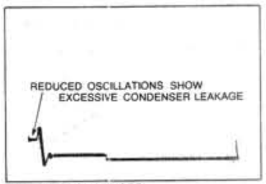
TYPICAL STANDARD IGNITION AND ELECTRONIC IGNITION PRIMARY PATTERNS



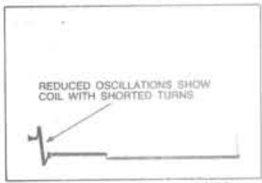
NORMAL PRIMARY SUPERIMPOSED PATTERN



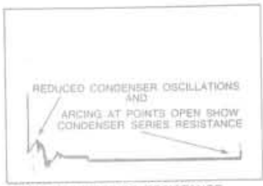
NORMAL PRIMARY SHIFT PATTERN
(PATTERN SHIFT/HOLD button pressed)



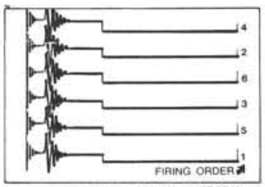
LEAKING CONDENSER
(Shorted primary coil windings give similar pattern.)



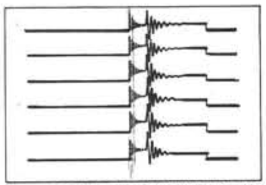
SHORTED PRIMARY COIL WINDINGS
(Leaking condenser gives similar pattern.)



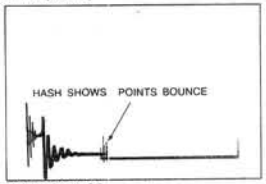
CONDENSER SERIES RESISTANCE
Look for: Loose connections, poor grounds, defective condenser.



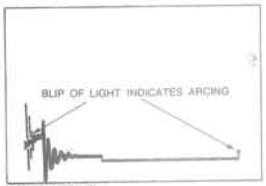
NORMAL PRIMARY RASTER PATTERN
(RASTER knob turned to right)



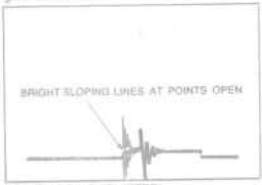
NORMAL PRIMARY RASTER SHIFT PATTERN
(RASTER knob turned to right and PATTERN SHIFT/HOLD button pressed)



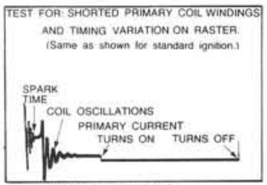
POINT BOUNCE
Look for: Weak point spring, pitted and misaligned points or loose points



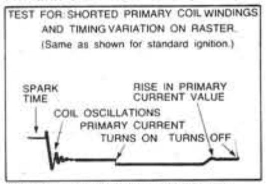
POINT ARCING
Look for: Defective condenser, misaligned, burned or pitted points, dirty points, too high charging voltage, defective ballast.



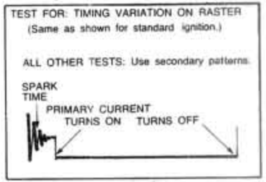
POINT ARCING (SHIFTED)
(Press PATTERN SHIFT/HOLD button.)


TEST FOR: SHORTED PRIMARY COIL WINDINGS AND TIMING VARIATION ON RASTER.
(Same as shown for standard ignition.)

FORD-BOSCH ELECTRONIC
NORMAL PRIMARY SUPERIMPOSED

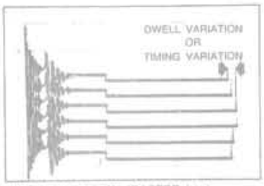

TEST FOR: SHORTED PRIMARY COIL WINDINGS AND TIMING VARIATION ON RASTER.
(Same as shown for standard ignition.)

AMC B.I.D./PRESTOLITE-DELCO HEI
ELECTRONIC NORMAL PRIMARY
SUPERIMPOSED


TEST FOR: TIMING VARIATION ON RASTER
(Same as shown for standard ignition.)

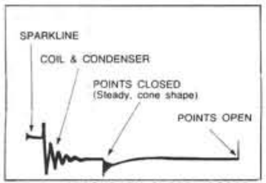
ALL OTHER TESTS: Use secondary patterns.

CHRYSLER ELECTRONIC
NORMAL PRIMARY SUPERIMPOSED

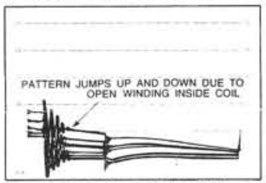


DWELL VARIATION (RASTER knob turned to right) Should not exceed 6°. 1° dwell variation = 1° timing variation.

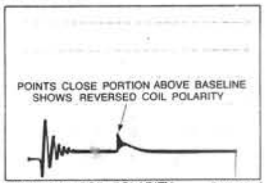
TYPICAL STANDARD IGNITION AND ELECTRONIC IGNITION SECONDARY PATTERNS



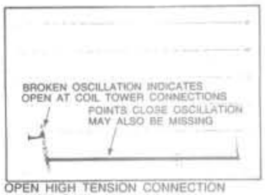
NORMAL SECONDARY SUPERIMPOSED PATTERN



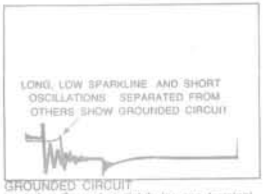
OPEN SECONDARY COIL WINDINGS



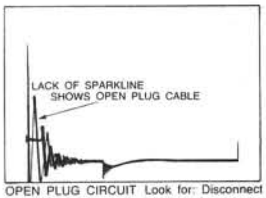
REVERSED COIL POLARITY Reversed primary connections, reversed battery connections, battery charged backwards, wrong coil



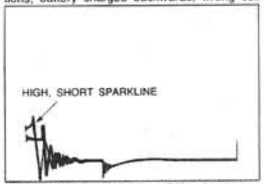
OPEN HIGH TENSION CONNECTION
Look for: Cable not seated, poor connections, open in H.T. cable.



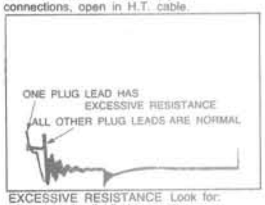
GROUNDED CIRCUIT
Look for: Grounded distributor cap terminal, fouled spark plug, grounded plug cable.



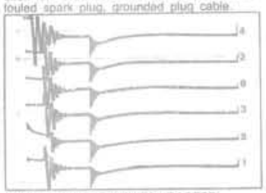
OPEN PLUG CIRCUIT Look for: Disconnected plug cable or defective (open) plug wire.



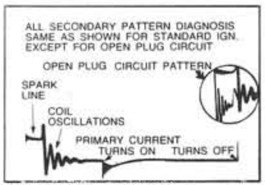
SERIES GAP Look for: Wide plug gap, cable not seated, open in cable.



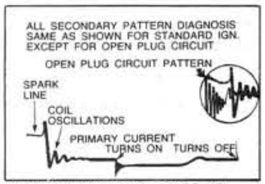
EXCESSIVE RESISTANCE Look for: Corrosion in distributor cap tower or defective plug cable.



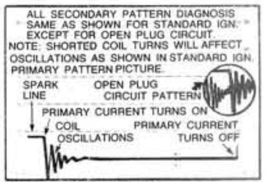
FAULTY PLUG CIRCUITS (RASTER)
Cylinders #5 and #4 show faulty sparklines.


ALL SECONDARY PATTERN DIAGNOSIS SAME AS SHOWN FOR STANDARD IGN. EXCEPT FOR OPEN PLUG CIRCUIT

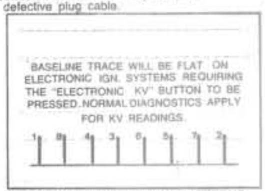
FORD-BOSCH ELECTRONIC
NORMAL SECONDARY SUPERIMPOSED


ALL SECONDARY PATTERN DIAGNOSIS SAME AS SHOWN FOR STANDARD IGN. EXCEPT FOR OPEN PLUG CIRCUIT

AMC B.I.D./PRESTOLITE-DELCO HEI
ELECTRONIC NORMAL SECONDARY
SUPERIMPOSED

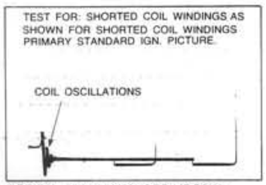

ALL SECONDARY PATTERN DIAGNOSIS SAME AS SHOWN FOR STANDARD IGN. EXCEPT FOR OPEN PLUG CIRCUIT.
NOTE: SHORTED COIL TURNS WILL AFFECT OSCILLATIONS AS SHOWN IN STANDARD IGN. PRIMARY PATTERN PICTURE.

CHRYSLER ELECTRONIC
NORMAL SECONDARY SUPERIMPOSED

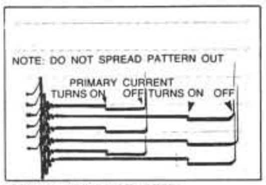

BASELINE TRACE WILL BE FLAT ON ELECTRONIC IGN. SYSTEMS REQUIRING THE "ELECTRONIC KV" BUTTON TO BE PRESSED. NORMAL DIAGNOSTICS APPLY FOR KV READINGS.

ELECTRONIC IGN. PARADE PATTERNS

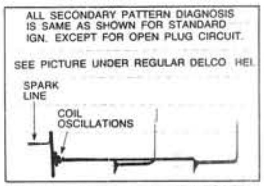
TYPICAL DELCO HEI V-6 PRIMARY AND SECONDARY PATTERNS


TEST FOR: SHORTED COIL WINDINGS AS SHOWN FOR SHORTED COIL WINDINGS PRIMARY STANDARD IGN. PICTURE.

NORMAL PRIMARY SUPERIMPOSED

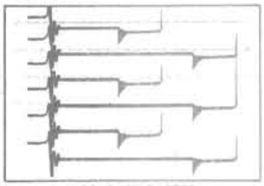

NOTE: DO NOT SPREAD PATTERN OUT

NORMAL PRIMARY RASTER

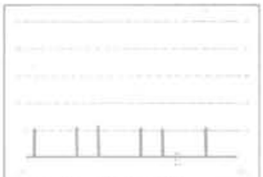

ALL SECONDARY PATTERN DIAGNOSIS IS SAME AS SHOWN FOR STANDARD IGN. EXCEPT FOR OPEN PLUG CIRCUIT.

SEE PICTURE UNDER REGULAR DELCO HEI.

NORMAL SECONDARY SUPERIMPOSED



NORMAL SECONDARY RASTER



NORMAL PARADE PATTERN

ADDRESS:	A number used by the CPU to specify a location in memory.
A/D CONVERTER:	(analog to Digital Converter) a device or devices which convert an analog signal to a digital word capable of being read by the computer.
ANALOG CIRCUIT:	A circuit whose output is proportional to its input.
ASTERISK:	The resultant character left on the screen inplace of the bullseye after a pick has been made. It has a star shape.
BAUD:	A communications measure of serial data transmission: bits per second.
BIT:	An abbreviation for "binary digit". A single piece of a binary number.
BULLSEYE:	A rectangular bright spot on the viedo monitor that we are allowed to change by using the lightpen to hit and pick it.
BUS:	A group of wires or printed circuit which allow memory, CPU, and input/output devices to exchange words. All devices are connected in parallel.
BYTE:	A sequence of bits operated upon as a unit. The most frequent size is 8 bits.
CLOCK:	A device that sends out timing pulses to synchronize the actions of the computer.
CPU:	(Central Processing Unit) The part of the computer system that controls the interpretation and execution of instructions.
D/A CONVERTER:	(Digital to Analog Converter) A device or assemblage of components that will take a word or words from the CPU which is composed of "ones and zeros" and output an analog signal.
DIGITAL CIRCUIT:	A circuit whose output is either a logic "one" or a logic "zero", with no intermediate steps.
EPROM:	Eraseable, programmable, read only memory. (see PROM)
FIRMWARE:	In general, software that is stored in ROM devices.
HARDWARE:	The physical parts of the computer.
HEXADECIMAL:	A numbering system using the digits from 0-9 and the letters A,B,C,D,E,F, to weighing of 16 possibilities per digit. Using this system, two digits form one byte.
INPUT/OUTPUT:	(I.O.) A general term for any device that can communicate with the CPU, in one direction (printer) or in two directions (monitor).
MEMORY:	That part of the computer which holds data and/or instructions.
MICROCOMPUTER:	A complete system able to function by itself.
MICROPROCESSOR:	Basically it consists of only the LSI chip or chips without memory or power supplies, etc.
MULTIPLEX:	A system whereby a computer can use, by the means of time sharing, a few lines to perform the equivalent task of many lines. This enables a computer system to be more compact, however it does slow down the speed of the computer to come to a decision.
NIBBLE:	A sequence of 4 bits or 1/2 byte operated on as a unit.
PROGRAM:	A collection of instructions arranged in such a manner to allow the computer to perform a specific task.
PROM:	(Programmable Read Only Memory) A device (integrated circuit) that is manufactured in such a way that the instructions put into it may be read from and not changed. The EPROM has the ability to be reprogrammed once it is erased.
RAM:	(Random Acess Memory) This type of memory is used for temporary storage of data. Its make-up allows it to be accessed at any point or place inside its memory bank, as compared to a stacked or serial addressed memory.
ROM:	(Read Only Memory) Memory that once it is programmed cannot be changed.
AMPLE AND HOLD:	A circuit which will sample an analog voltage (usually) without destroying its integrity and the hold that value until the CPU can measure it.

SIGNATURE: A group of hexadecimal numbers used by the CPU to set up the proper circuits for a specific test. The signature of a computer board can help us determine where a problem may exist.

WORD: The basic group of bits which is manipulated by the computer in a single step. Two types of words are used by the computer, data and instruction words.

SERVICE TECHNICIAN'S EMISSIONS ANALYZER KIT

CONTENTS

1. 25731 - INSTRUCTION SHEET - This page and 9 others.
2. 30102 - MALE ADAPTER - White fitting for 3/8" I.D. Hose.
3. 30266 - SEA/EPA VIDEO CABLE
4. 30267 - INTERIOR RS-232 TEST PLUG
5. 30268 - FLOW METER - From Dwyer, scaled in cubic-feet per hour.
6. 30269 - INLET RESTRICTOR VALVE
7. 30270 - SERVICE KEYBOARD ASSEMBLY - Similar to EPA 53-500 Keyboard, with custom sheetmetal.
8. 40152 - ELBOW - White elbow for 3/8" I.D. hose (2).
9. 42072 - HOSE CLAMP (2)
10. 42414 - STRAIGHT FITTING, 1/4" NPT - Black fitting for 1/4" I.D. Hose.
11. 42520 - MALE QUIK-DISCONNECT - Brass fitting for 1/4" I.D. Hose.
12. 43083 - INTERIOR KEYBOARD HARNESS - CPU board edge connector on one end and one large (16-pin) and one small (4-pin) panel mount receptacle on the other.
13. 6256072 - 1/4" I.D. x 1/16" HOSE, 3.5 FEET - Standard I.R. plumbing hose.
14. 30278 - EXTERIOR RS-232 TEST PLUG

SERVICE TECHNICIAN'S EMISSIONS ANALYZER KIT

ASSEMBLY

NOTE: These instructions assume that the STEAK is completely unassembled, except for the wire harnesses. When purchased under the kit part number very little assembly is required.

30278 EXTERIOR RS-232 TEST PLUG - No assembly required.

30266 SEA/EPA VIDEO CABLE - No assembly required.

30267 INTERIOR RS-232 TEST PLUG - No assembly required.

43083 INTERIOR KEYBOARD HARNESS - No assembly required.

30268 FLOW METER

a. Screw the 40152 elbows into the back of the flow meter. The metal brackets provided with the Flow Meter can be fashioned into hangup hooks. See Fig. 1 on Page 3.

b. Cut off a 12" section of hose.

c. Push the hose onto the elbow on the bottom of the Flow Meter.

30269 INLET RESTRICTOR VALVE

a. Install the two straight fittings in restrictor valve.

b. Push the remaining 30" section of hose onto the 1/4" straight fitting on the restrictor valve.

c. Slide the two hose clamps over the hose.

d. Insert the Male Quick-Disconnect into the hose and clamp the hose at both insertion points.

30270 SERVICE KEYBOARD ASSEMBLY

a. Position the keyboard support upside down on a smooth, clean, flat surface. The slot for the touch panel ribbon cables must be on your left.

b. Mount the keyboard PCBA, edge connector to the right, on its' mounting studs, using only three (3) screws. Leave the screw stud at the lower right open at this time.

c. Invert the keyboard support, leaving the slot for the cables on the left.

d. On a smooth, flat surfact, without bending the matrix, remove the plastic coating that covers the adhesive backing of the touch panel.

e. Line up the right edge of the touch panel with the right edge of the keyboard support. (The ribbon cables must be over their slot.)

f. When the touch panel is aligned, press it firmly into place.

g. Guide the ribbon cables through their slot.

h. Invert the keyboard support.

i. With a firm grasp on both edges of the ribbon cable, immediately adjacent to the uncoated conductors, insert the ribbon cables squarely into J1 and J2 on the keyboard PCBA.

j. Plug the exterior keyboard harness into J3, locking edge up.

k. Secure the harness ground strap at the lower right mounting stud of the PCBA.

NOTE: If you want a muted output from the keyboard beeper, put a strip of masking tape over the beeper.

l. Set the keyboard cover in place and install ten (10) mounting screws. The cover is symmetrical.

m. Push the exterior keyboard harness into the keyboard assembly 1/2" to 1" and install the strain relief. This should eliminate stress on the edge connector wiring.

n. Install the support brackets over the edges of the keypad and secure them with two (2) screws each.

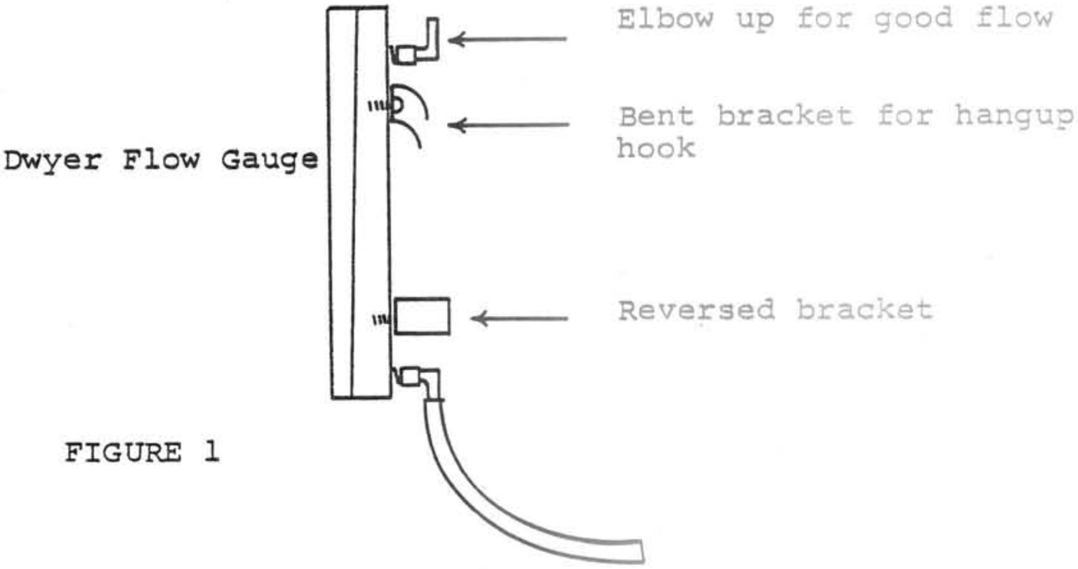


FIGURE 1

OPERATION

A. KEYBOARD HARNESS SECURITY

The STEAK was built using standard parts as much as possible. Because of this, the ground strap on the interior keyboard harness is terminated with a ring terminal. To save wear and tear on this harness and the edge connector to the CPU in the 4-Gas Analyzer, remove the ring terminal and install a standard (Allen P/N 2385) alligator clip. Attach this ground clip to a convenient ground point while using the STEAK keyboard.

B. KEYBOARD CPU CONNECTION

The edge connector on the keyboard harness goes to J2 on the CPU Board. Please mark the top and bottom sides of the plug so that you always install it letter-side-up. All but one of the letter-side pins are dummies.

C. 53-500 SERVICE MANUAL (P/N 25723)

Although the following instructions are very complete, they are not intended to replace the service manual for the 53-000 series of microprocessor-based emissions analyzers. The following charts from manual #25723 will be necessary and/or helpful.

1. Test Point Illustrations, Page 36.
2. Signal Conversion Charts, pages 43, 45 & 47.
3. Resistance/Temperature Chart, page 64.

Theory of Operation, Troubleshooting, and Module Removal and Insertion articles will make fascinating reading, too.

4-GAS ANALYZER ELECTRICAL CALIBRATION PROCEDURE

EQUIPMENT REQUIRED:

1. Service Technician's Emissions Analyzer Kit (P/N 31585), or equivalent.
2. BAR 84 Cal Gas (P/N 42899), or equivalent (1.60% CO, 600 ppm HC, 11.0% CO_2).

I. SET UP

A. Make sure that the analog PCBA (P/N 5000970-4) is in the top slot of the card cage, with the detector cables from the optical assembly routed through a cable clamp attached to the ceiling of the cabinet. The CPU Board (P/N 5000983) should be in the lowest slot, and the digital board in the second lowest slot.

B. Connect the Video Cable to the video output jack on the Digital Board (P/N 5000963) and the S.E.A. Video Input Cable.

C. Connect the Interior Keyboard Harness to J2 on the CPU Board (P/N - 5000983).

II. TESTING

A. Turn the unit on. The pump should start running. "WARM UP IN PROGRESS - Waiting for Temperature to Stabilize" will be shown on the monitor. Manual Mode and Self Diagnostics LED's will stay on.

NOTE: If the Self Diagnostics routine stops (one or more LED's flashing) refer to Power-On Self Test (page 27) in the Troubleshooting Section of 53-500 Manual.

B. Press the "ESCAPE" key. The word "Escape" and a cursor will appear in the lower left corner of the screen. Type "MENU" and press the "ENTER" key. The "QUICK BROWN FOX" setup screen will appear. Check the software level and checksum:

Version 4.6 Checksum = ABD7
Version 4.7 Checksum = F75A
5.1 " 2FBD ← NEW CPU

C. BASIC FLOW AND FLOW SWITCH

1. Press the "ESCAPE" key.
2. Type "PROBE MANUAL", and press the "ENTER" key. The Manual Mode Screen will appear, with four gas readings.
3. Connect the flow gauge to the exit hose from the optical bench.

4. Plug the small drilled hole in the elbow with your finger. The minimum flow through the system should be greater than 14 CFH. If not, refer to the Troubleshooting section of the 53-500 service manual.

5. Connect the restrictor valve to the exhaust hose inlet.

6. With the small drilled hole in the elbow open, use the restrictor valve to lower the flow gauge reading below 5 CFH. The light should come on, indicating low flow.

7. Slowly increase flow until the flow light goes off. Note the flow gauge reading; it should be between 7 CFH and 9 CFH. If not, adjust the flow switch until the system responds as described.

   NOTE: CW adjustment of the flow switch set screw will increase the amount of flow required to turn the flow light off.

   NOTE: To accomplish this adjustment from the rear of the unit, monitor the signal line of the flow switch:

   5.0v = LED On
   0.0v = LED Off

8. Press the "CONTINUE" key to proceed to the next step.

   NOTE: Type "NONE" and press the "ENTER" key to stop the pump, if desired.

D. Type "SET-TIME" and press the "ENTER" key.

1. Type the full year and press "ENTER".
2. Type the number of the month and press "ENTER".
3. Type the date, press "ENTER".
4. Type the number of hours (24 hour time) and press "ENTER".
5. Type the number of minutes and press "ENTER".

NOTE: The last "ENTER" will take you offscreen.

E. Type "TAMP-TEMP" and press the "ENTER" key. The screen will show five sentences:

1. "The Bench was WARM (or COLD) at Power On."
2. "The Bench was WARM (or COLD) after Tape Load."
3. "The Bench is now WARM (or COLD)."
4. "The Cassette Tamper Switch is OFF (or ON)."
5. "The Back Panel switch is OFF (or ON)."

NOTE: If the third sentence says the bench is now COLD, it should switch to WARM within one minute.

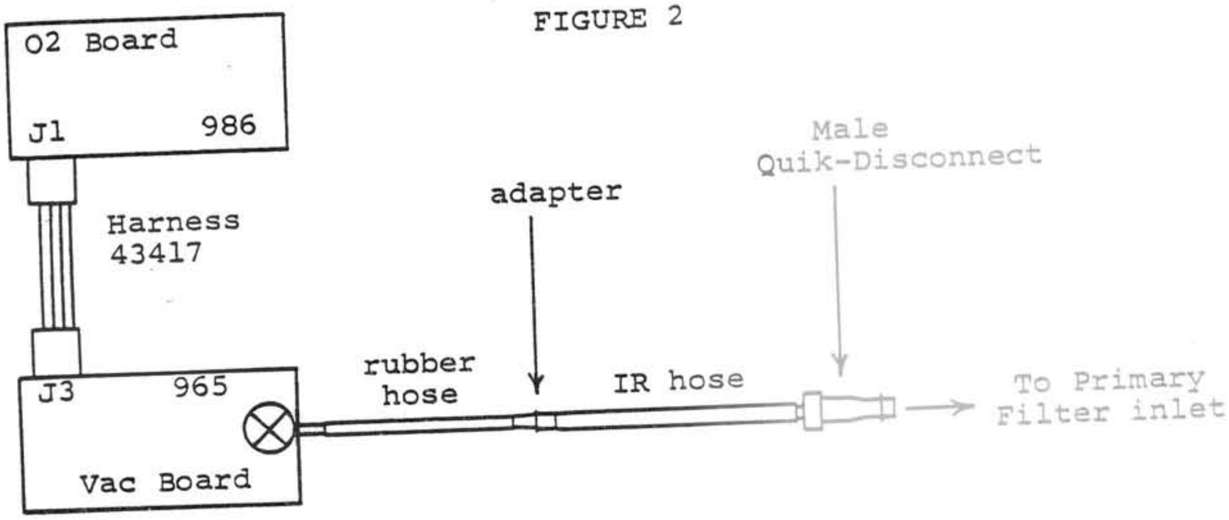
F. LEAK Test (Optional, Series "A" Units).

1. In order to perform a LEAK test on a 4-Gas Analyzer, a Vacuum Transducer system will have to be temporarily added to the Analyzer. Also, a drain hose plug might have to be used to successfully pass the LEAK test, if the Check Valve and the reed valves of the pump cannot seal tightly enough.

2. The Vacuum Transducer system consists of the following parts:

   a. O2/Vac Harness - 43417.
   b. Vac Transducer Board - #5000965.
   c. 5/32" I.D. Rubber Hose (6" of 6256028).
   d. Hose Adapter (or Hose Barb, 29360 and Elbow, 40168).
   e. 1/4" I.D. IR Hose (6" of 6256072).
   f. Male Quik-Disconnect.
   g. Drain Hose Plug (from Plug-All, 41922).

FIGURE 2



3. Type "LEAK" and press the "ENTER" key. "Cap End of Exhaust Probe" will be shown.

4. Attach the Male Quik-Disconnect to the Primary Filter Inlet and connect the O2/Vac Harness to J1 on the O2 Board, as shown on Figure 2. Select "CONTINUE".

5. "CHECKING VACUUM" will show on screen for about 15 seconds, followed by the results of the Leak Test.

```
       CHECKING VACUUM
 Full Vacuum Draw   =  520
Allowed Leak Down   =  390
 Vacuum Leak Down   =  502
```

"Allowed Leak Down" is 75% of "Full Vacuum Draw." The test is failed if vacuum drops over 25%. Select "CONTINUE".

6. While "Take cap off end of exhaust probe" shows onscreen, remove the Vacuum Tansducer System. Select "CONTINUE"; the test is complete.

G. Electrical Calibration (5000970 Board)

NOTE: The Test Points for ELECT-CAL are illustrated on page 36 of the 53-500 manual.

1. Type "ELECT-CAL" and press the "ENTER" key.

2. The following message will show onscreen:

   "BE SURE THE BENCH IS WARM (ON FOR 7 MINUTES). ADJUST AGC VOLTS TO -1.8V. ADJUST -5 VOLTS."

3. Connect the negative probe of your DVM to TP1 of the Analog Board (5000970).

4. Connect the positive lead of your DVM to the Test Points listed, and use the corresponding potentiometer to set the correct voltage.

HC AGC	TP15	R83	1.80v ± .05
CO AGC	TP14	R80	1.80V ± .05
CO2 AGC	TP13	R77	1.80V ± .05
HC ZERO	TP8	R84	-5.00V ± .05
CO ZERO	TP6	R81	-5.00V ± .05
CO2 ZERO	TP4	R78	-5.00V ± .05

   If any Test Points do not respond properly, refer to the Troubleshooting Flow Charts.

5. Select "CONTINUE"; "ZEROING BENCH" will stay onscreen about 30 seconds.

6. Use R7 on the Oxygen Board (5000986) to set -4.500 volts, ±.05, onscreen when the unit shows this message.

   "SET O2 GAIN TO MIDRANGE"

   This setting will be repeated.

7. Select "CONTINUE". The A/D READINGS screen will be shown. "Sam Channel" readings represent the settings made on the +5.00 Volt Zero Line; "Span Channel" readings show the voltages used by the A/D Converter to produce the gas concentration readouts.

8. Use the Signal Conversion Charts to find the appropriate voltage readouts for the calibration gases you are using. Note them, and be sure to use the unit's Propane Equivalency Factor for the HC reading.

9. Inject Cal Gas at 15 psi into the Internal Gas Port. Set the span channel readouts to the correct voltages, using the potentiometers listed in the following chart. The readings can be double-checked with a DVM at the Test Points shown. After these settings are made, no adjustments may be made to the AGC or zero settings without a complete re-execution of ELECT-CAL.

Coarse Gas Cal (5000970)

HC	R85	TP9
CO	R82	TP7
CO2	R79	TP5

WARNING!: Cal Gas should not be injected into the exhuast sample exit hose at 15 psi. There is no restrictor in the exit hose and the sample chamber windows could be destroyed.

10. Reduce the Cal Gas output flow to 1 or 2 psi. Select "CONTINUE". "SET O2 OFFSET TO 0 VOLTS" will show onscreen.

11. Let the Cal Gas flow for one minute, as the O2 readout stabilizes. Use R4 on the O2 Board (5000986) to set O2 readout to 0.00v, ± .01v.

12. Select "CONTINUE". ELECT-CAL is complete.

H. Type "ZERO O2-5 VOLT" and select "ENTER". "ZERO" turns on the pump, solenoid V1, and solenoid V2. "O2-5VOLT" selects that named routine.

1. In spite of the onscreen admonition to "SET O2 GAIN TO 5 VOLTS", use R7 on the O2 Board (5000986) to set the readout to -4.500v, ± .05.

I. Type "GAS-CAL" and press "ENTER". Enter the Propane Equivalency factor of the unit, and the concentration values of the gas bottle attached to the unit.

1. Use no decimal points.
2. Enter 3 digits.

While "CALIBRATING Flow Lite should be off!" is showing, the unit is zeroing bench.

3. Turn the Cal Gas on, at 15 psi when instructed. The unit will now set its reference for gas readouts to the gas you have told it you are applying.

4. When you hear a solenoid activate, and the pump turn on, TURN OFF THE CAL GAS. After the unit displays the various readings taken in the course of GAS-CAL, the routine is complete.

J. Type, "?WARM", and press "ENTER".

1. "*** WARM UP IN PROGRESS***" shows while the bench is zeroed.

2. Four gas readouts will be displayed during the Stability Check. Fresh air is sampled every 60 seconds, and a check is made to see if the readouts stay under specification.

CO	0	(.04%)
HC	0	(4ppm)
CO2	0	(.8%)
O2	212	(.7%)

3. The following readouts signal the completion of "?WARM". Any problems seen will be enclosed in stars.

HC Zeroing - Explained under J2.

Zero DAC Setting - A decimal number representing the byte used to fine-tune the DAC gain while in the zero mode; it should be about mid-way between 0 and 255.

Calibration Gain Deviation - The percentage of change in gain from the last Gas Cal to the most recent Zero Bench routine; the allowable deviation changes with software. At this writing, 6% or less.

K. Type "INT-CAL GAS-CHECK", and press "ENTER".

1. When the Gas Check screen comes up, inject Cal Gas into Internal Gas Port at 15 psi. Check the readout for accuracy as listed:

CO	0.00 ,	± .06
HC	0 ,	± 12
CO2	0.0 ,	± .4
O2	21.0% ,	± .7%

2. Press "CONTINUE".

L. Type "RESTART and press "ENTER" to return the unit to the communication mode with the S.E.A.

1. The self-diagnostics routine and a complete warmup will be run.

ALLEN GROUP

Testproducts
Division
2101 North Pitcher
Kalamazoo, Michigan 49007

SERVICE BULLETIN

No. 010
Date 7/7/83

SUBJECT: FM2 Simulator Mods
EQUPMENT AFFECTED: FM2 Simulators
ACTION REQUIRED: Informational, file in FM2 Service Manual, 25687

The following is a list of possible problems with FM2 Simulators and their most likely causes.

1. Erratic Variable RPM operation - Probable cause: Cold solder joint on C15 - Repair: Re-solder

2. Timing readout erratic above 2000 RPM. Normal operating characteristic.

3. Intermittent amps output - Probable cause: Edge connectors on the PCB - Repair: Replace edge connector pins #18, #17, #15, #13, #12, #11, #10, #8, and #9 (#9 pin might not be used on your simulator) - the edge pins are Allen P/N 29046 Hardwire

NOTE: The above problem will appear to be caused by switching, but this is not usually the case.

4. Crank-To-Charge Amp Shift (applies to Green PCB Simulators ONLY). Description: Charge amps occasionally jumps from 60 amps to 170 amps while switching from Crank to Charge. Probable cause: R59, (located on the heat-sink) is 7.5 ohms, 22 watts. Repair: Change R59 to 1[illegible] ohms, 20 watts, or add a 4 ohm, 20 watt resistor in series with R59. Allen P/N 29385.

5. Variable Volts Current Limiter - Description: It is possible, if variable volts is turned up to 20 volts or more, and the output pin is pulled to ground, (i.e., points resistance or crank kill while the points lead is clipped to the output pin) that the variable volts potentiometer will be burned out. Probable cause: No current limiter in series with the potentiometer. Repair: Install a 220 ohm, 1/4 watt resistor in place of the jumper from the PCB to the selector switch. The tie point for this jumper is marked "20". The resistor will burn out in place of the potentiometer. The potentiometer is 10K ohms, 1 watt, 270° turn.

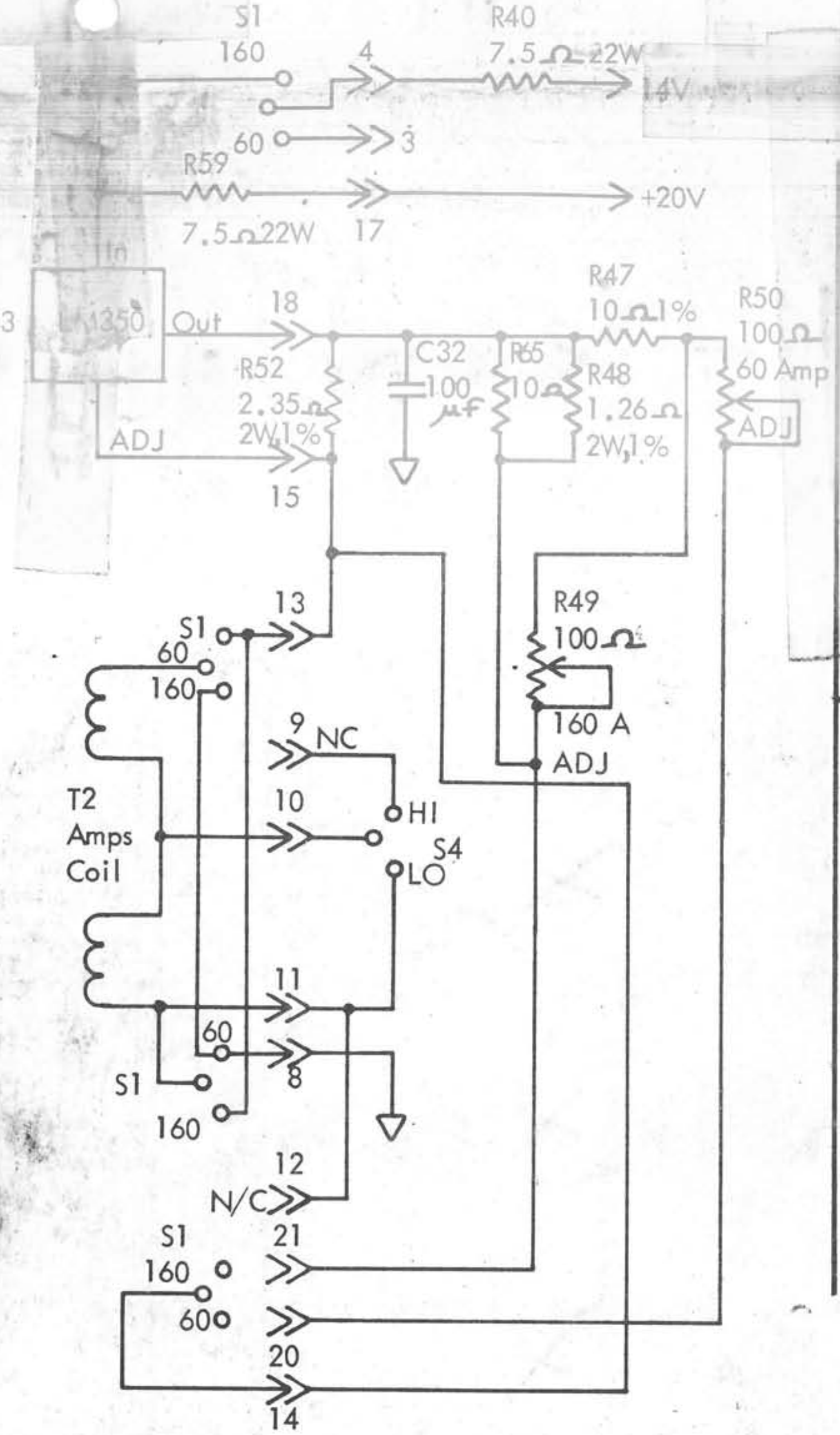
Calibration Procedure Changes

Volts: On simulators which have a jumper PCBA in place of U18, the potentiometer closest to the LM336 chip is the 1.5 Volt adjust. The other potentiometer is the positive and negative 12V adjust.

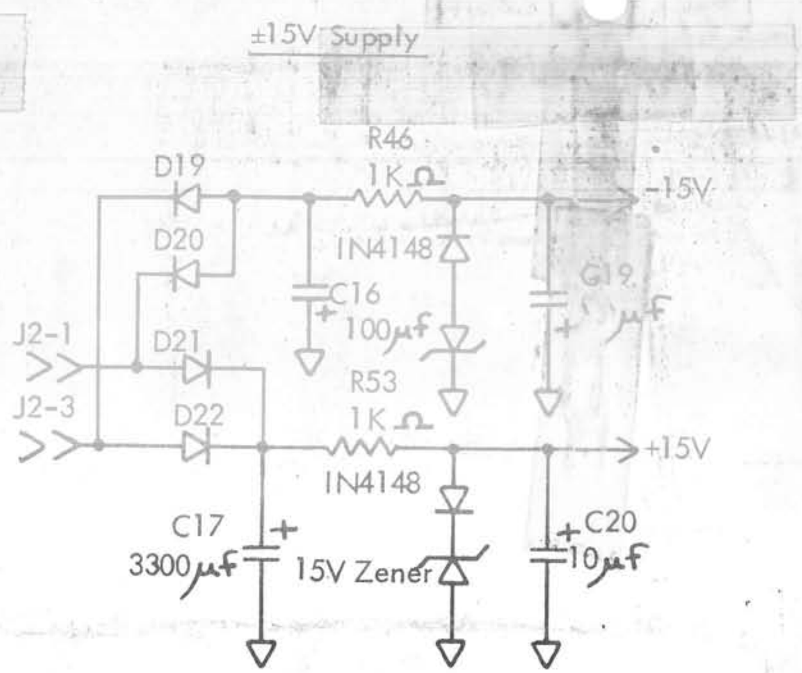
Amps: See Step A. Simulators which have a green PCBA do not have a 9 Volt adjustment potentiometer (R73).

KV: See Step B. Adjust R72 so the negative portion of the spike is minus 12 Volts, not minus 6 Volts.

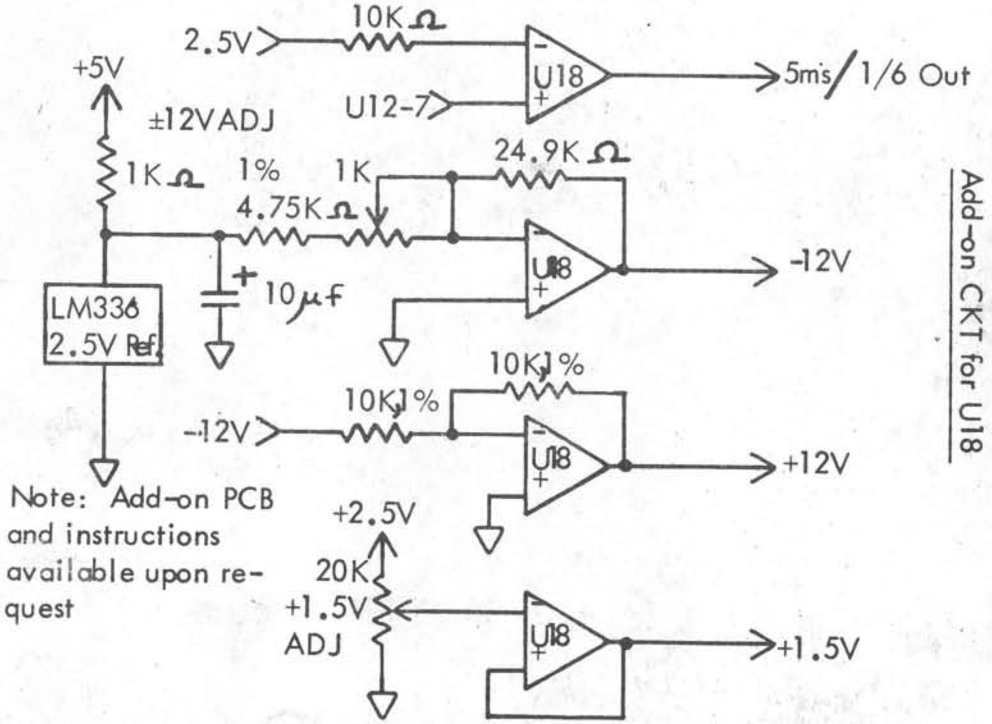
Amps Supply



±15V Supply



Add-on CKT for U18



Note: Add-on PCB and instructions available upon request sary for changing hardware, software and -370 configurations, see the October You Know.

New distributorless ignition systems

BACKGROUND

There are three new distributorless ignition systems for the 1987 model year. You'll find them on the new 2.0L and 2.5L cylinder engines and the 2.8L V6.

The current Model 32-370 (Update C) Distributorless Ignition Adapter works on all 1984-1986 GM distributorless ignition systems, plus 1987 3.0L and 3.8L V6 engines. It allows the Smart Scope, Smart Engine Analyzer, and Digital Engine Analyzer to do an "All Systems Test" on engines with these ignition systems.

Engineers are now developing an adapter (Model 32-370D) for these '87 ignition systems. It will be significantly different from the previous Model 32-370 Distributorless Ignition Adapter. The 32-370D will be available about March of '87, at an estimated customer cost of $995.

Customers who now own a Distributorless Ignition Adapter may have them updated to the "Series D" configuration at an estimated cost of $300. We estimate availability in March, 1987.

SEA Level 3 and Smart Scope Level 10 software are required for the adapters. No change necessary for the DEA.

1987 GM 160 BAUD DATA STREAMS

The 8192 baud data stream is not used on all vehicles. Customers with SEA Level 4 and S/S Level 10 can test the following 1987 cars models. They must enter the vehicles as 1986 models.

Model	VIN Code (8th digit)
Chevette/T1000 (1.6L)	C
iero (2.8L)	9
Grand Am, Calais, Somerset (3.0L)	L
Bonneville, Regal, Ciera, 98, 88, Century, Electra, Le Sabre (3.8L)	7, 3
Monte Carlo, Gran Prix, Cutlass Supreme, Regal (3.8L)	A
Caprice, Monte Carlo, Gran Prix (4.3L)	Z
Monte Carlo, Caprice, Camaro, Firebird, Gran Prix (5.0, 5.7L)	G, H, 6
Cutlass Supreme, Brougham Caprice, Parisienne, Cutlass Cruiser (5.0L)	9, Y

DELCO-LOC RADIOS FOR 1987

Pontiac Dealer Service Bulletin #87-8-1

The "Delco-Loc" radio (installed in the 1987 6000 STE) won't work if removed from the car and installed in another vehicle. That makes it less attractive to thieves.

A small complication is that it thinks it's been removed if you interrupt battery power. This could happen when you clear trouble codes or use the 10X multiplier to check for current leakage. Here's the procedure from the service bulletin.

"NOTICE: Whenever a battery cable is disconnected (or 12 volt power is lost), the STE Delco-Loc radio will be inoperative when 12 volts is reapplied. "LOC" will appear on the graphic display. Turn ignition and radio ON, then press the MUTE button on the steering wheel control to reactivate the radio."

NEW CHRYSLER INFORMATION

Jeff Moore, Memphis

I attended a fuel injection class at a local Dodge dealer. Here are some helpful hints for the recent Chrysler vehicles.

1. Chrysler's cruise control allows a vacuum leak at any engine speed, any time the system is active but not engaged. Make sure the cruise control is OFF when trying to adjust idle mixture, base idle speed or propane enrichment.

2. The new 3.9L V6 engine (used in the pickups and vans) has several notable differences. At idle, air management is "upstream" but switches downstream as soon as the engine comes off idle. This is to improve emissions due to the great amount of valve overlap designed into the engine.

3. To Check base timing on the 3.9L
- Engine at operating temperature.
- Unplug the computer's vacuum transducer and plug hose.
- Disconnect carb idle switch and make sure it isn't grounded.

4. FWD EFI and Turbo engines use timing to adjust idle speed. Chrysler calls this "Spark Scatter". (It's like the Bosch CIS Idle Compensator). The computer adjusts timing ± 12° to maintain the programmed idle speed. The Automatic Idle Speed (AIS) motor is used only for:

- Backup idle control (Limited Operating Strategy)
- A/C request.
- Hot restart
- Deceleration.

5. The brake switch is used only to indicate closed throttle if the Throttle Position Sensor fails.

6. The on-board computer directly controls the A/C compressor through the A/C cutout relay and the fan relay.

7. Some Chrysler vehicles will now have a 3-wire heated oxygen sensor which incorporates a positive temperature coefficient thermistor.

8. Starting in 1986, the Auto Shutdown Relay is incorporated into the power module, although it is still controlled by the Logic Module. If the relay goes bad, the Power Module must be replaced.

9. Fuel Pressure specifications (± 2 PSI)

84-85 EFI = 36 PSI
86-87 EFI = 15 PSI
84-87 Turbo = 55 PSI (Pressure regulator vacuum line disconnected and plugged. 48 PSI with line connected.

HARDWARE CHANGE FOR CHRYSLER DIAGNOSTICS

Jim Walters, Engineering Dept, KMZ

In order to test 1985 and newer Chrysler carbureted on-board diagnostics, we made a modification to the Chrysler Adapter Harness. The new part number is 43364-1. The dash-1 has five terminals, the older model has six. If you have the original part (no dash number), you won't get any diagnostic functions on carbureted engines. Units sold with Level 2.3 should already have the -1 harness.

PROTECTING THE POLICE: PROCEDURES FOR MUNICIPAL GARAGES

B.J. Liesenfelt, Miami

In Miami recently, a police officer died of Carbon Monoxide poisoning while writing reports at the end of his shift. We developed this test to determine whether officers (or anybody who might be in an idling car for long periods) are being exposed to CO.

Test Procedure:

1. Perform a Complete Systems Analysis to make sure the engine is running OK. Make ALL repairs indicated.
2. Go to the Certification Mode (SEA and DEA) to obtain 4-gas tailpipe readings. Print the results.
3. Insert the needle probe adapter into a window. Close all the other windows.
4. Allow the engine to idle with the AC or heater on MAX (for maximum air recirculation).
5. Take CO readings periodically.

Any indication of CO in the passenger compartment could be fatal with long term exposure. Remember, police officers spend 12 hour shifts in their cars, often with the engine idling, so even small concentrations build up in their bodies.

6. Raise the car on the hoist and use the needle probe to check for exhaust leaks along the exhaust system, concentrating on the joints and connections. (S/S Reference 10-746, SEA Reference 17-24, DEA Reference 737).

CAUSE OF LEAN MIXTURES: GM CCC SYSTEMS

Jim Moore, North Canton

Problem: the M/C solenoid inoperative because it is grounding out. The car runs very lean (surges, lacks power, dwell fixed at 55°).

Cause: I've found several cases recently where the EGR and EFE solenoids short out, which shorts the mixture control solenoid to ground.

Diagnosis: with the key on and engine off, the bad solenoids "clatter" (clack-clack...clack-clack) and you get a weak check engine light. When you unplug the solenoid, the problem goes away.

I'll tell you something else: oxygen sensors in those cars are real clean.

ADVANCED SS/SEA CLASSES

Dave Chamberlain

Did you know that some of the primadonnas in your SEA class complain about "spending the first night learning how to wash the cabinet?"

You might consider an advanced Smart Scope or Smart Engine Analyzer class once a month. It can be a 2 or 4-hour evening class designed for the hotshots who want more than the basics and want to wring out the most from their machine. You can talk about some of the advanced Pattern Display/Special Probes techniques, reading ALDL, Secondary Analysis...whatever. It will be an excellent opportunity for you to learn from them as well as show off what the unit will do.

A FRIENDLY REMINDER

ALL pay school revenues must be sent to the following address:

Allen Testproducts
2101 N. Pitcher
Kalamazoo, MI 49007
ATTENTION: Ardis Wright

DO NOT send money to the Kalamazoo Mall address.

MANUALS

Order your personal DEA manual at the same time you order supplies for your classes. This procedure will save mailing costs. Manuals have been available since 9/14/86.

Here's your price structure so you can retail the Programmed Training Course manuals in your classes.

Smart Engine Analyzer (25711-2)	$ 20.25
Digital Engine Analyzer (25762)	21.00
Smart Scope (25643-100)	30.00

TRAINING DEPARTMENT SNIGLETS

Scroom (v) verbal gesture of defiance, especially toward authority. Similar to **Tellwiddem**. (Steve Juenemann, Service, KMZ)

Romstance (n) attitude characterized by inability to listen to other viewpoints. Just like a Read-Only Memory, whose contents can be read but not altered. A person who has a Romstance will tell you what he thinks but refuse to listen to what you say.

Ramstance (n) attitude characterized by lack of opinions or conviction. (Dave Chamberlain, KMZ)

ALLEN GROUP

TRAINING TECH TOPICS

July, 1986

Number 13

TRAINING TECH TOPICS FIRST BIRTHDAY

(Uncle Dave looks back)

Well, well, well. Look at you! How you've grown since I saw you the first time! Kid, it's been great watching you grow up. You were so small when you were young...just 2 pages. About 40 people saw you.

Look at all you've done in this past year. You're distributed to all of the service department, lots of the engineering department and you have the respect of most of the company.

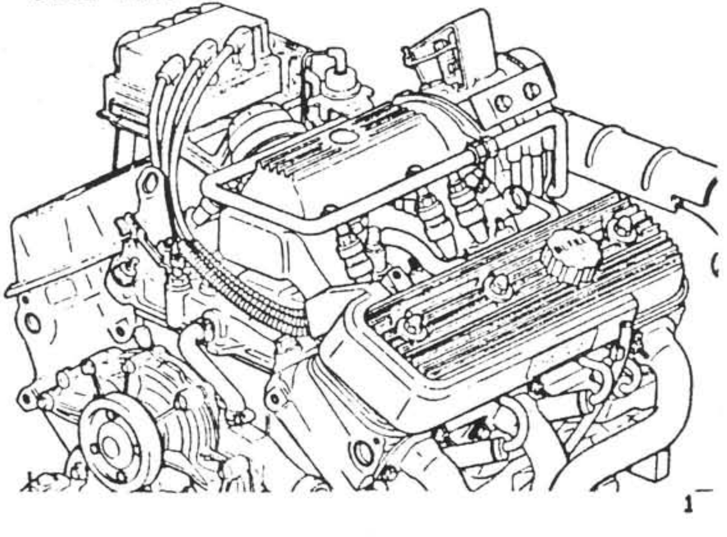
You may not know how you got so successful, but I do.

Come sit on my knee and I'll tell you. It's all of your contributors. It's all the instructors from coast to coast who are sharp enough to find something new and share it with everybody else. It's all the guys that are willing to take the initiative, willing to spend the time to make a contribution. Don't take it personally, TTT, but you owe your success to everybody out there.

Give 'em a big hand, kid. They earn it each and every day.

GM DISTRIBUTORLESS IGNITION

General Motors distributorless ignition system are here in a big wayu, and Allen Testproducts has the only operating adapter. These systems, dubbed Computer Controlled Coil Ignition (C3I) or Direct Ignition System (DIS), were first introduced in the 1984 Buick turbocharged 3.8L engine. In 1985, it was added to 3.0L V-6 engines in the General Motors "N" car (Buick Somerset Regal, Oldsmobile Calais and Pontiac Grand Am). In 1986, it is standard equipment on nearly all fuel injected Buick, Olds and Pontiac 3.0L and 3.8L V6s.



OPERATION

In the DIS/C3I system, there is one double-ended ignition coil for each two cylinders.

Based on a signal from a crankshaft position sensor (which senses when each of the 3 pairs of cylinders is at Top Dead Center), the on-board computer signals the ignition coil to fire the spark plugs in the two companion cylinders. A camshaft position sensor supplies a sync signal to tell the computer when a specific cylinder (or pair of cylinders is at TDC). The plug fires each time the piston approaches TDC, instead of every other time.

One of the spark plugs fires at the normal time, in the cylinder that is on its compression stroke.

The other spark plug fires a "waste spark" in the companion cylinder, which is on the exhaust stroke.

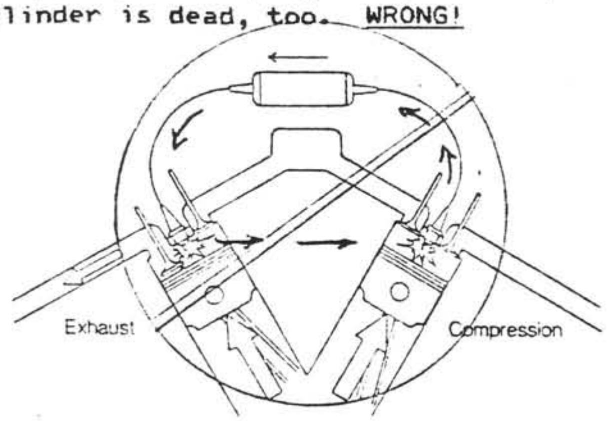
This means that each spark plug fires

RANDEE KYRO
TRAINING

twice per camshaft revolution instead of once.

THE MYTH ABOUT DISTRIBUTORLESS IGNITION

"If you open one plug wire, the companion cylinder is dead, too. WRONG!



"The electrons in the secondary circuit flow through the positive plug wire, across the gap, through the block across the electrodes and back to the opposite end of the coil. If you open a wire, that breaks the electron flow." WRONG!

1. There would be too much attenuation in that circuit; The coil can't produce enough voltage to jump both the gaps.

2. If there was a problem in one side of the secondary circuit (such as an open wire or a dead injector), the other cylinder would die. That would cause unacceptable driveability and emissions problems.

THE TRUTH

Because of the high ignition coil voltage, the secondary -to-primary capacitance and the "Distributed capacitance" of the plug wires, the electrons find an alternate path to complete the circuit.

That's the reason that you can open one plug wire and the opposite plug still fires.

There's another important reason there is no connection between primary and secondary; the "waste spark."

WASTE SPARK

The waste spark fires during the exhaust stroke, so it doesn't require much energy to fire. The coil's energy is concentrated in the compression cylinder where it is needed the most. The waste spark has a very low peak KV and short firing time.

At the same time, the other plug on that coil (firing in the compression cylinder) is using more of the energy from the secondary windings in the coil.

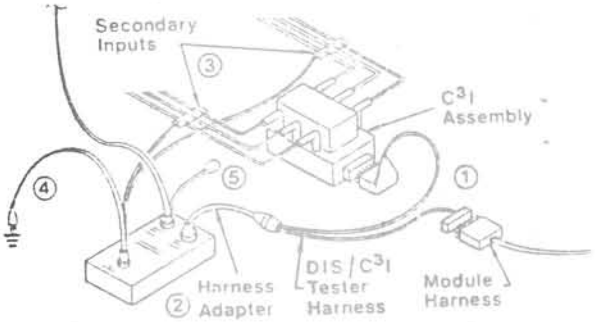
WHAT THE DISTRIBUTORLESS IGNITION ADAPTER DOES FOR A LIVING

All of this means the distributorless ignition adapter must perform three complex tasks:

1) It must separate the waste spark waveforms from the normal waveforms.

2) It must reverse the polarity of half the normal waveforms.

3) It must kill cylinders without having access to the multiple ignition coils.



When the adapter is attached to the analyzer, the operator can:

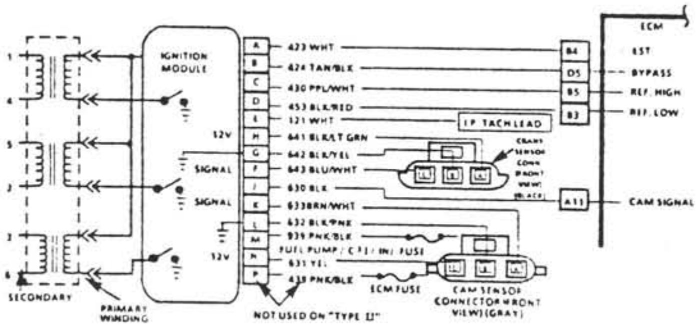
1. Read all ignition secondary waveforms directly on the oscilloscope screen (when using the Smart Scope).
2. Kill cylinders for Power Balance tests and cranking tests.
3. Perform complete and individual systems Automatic Tests using the Smart Scope or the Smart Engine Analyzer.

PRIMARY, TIMING TESTS

There is no access to the multiple ignition primary circuits with the engine running, so ignition primary results are not possible with this system.

Because timing is not adjustable, timing test are not necessary. Ignition timing in the DIS/C3I system is handled entirely by the on-board computer.

DIS/C3I COMPONENTS



IGNITION MODULE

This is the electronic module under the coil assembly. It has a 14-pin connector at one end. Primary switching and signals to the ECM are all handled in the ignition module.

Any failure in this system generates the same trouble codes and acts the same as other GM ignition modules.

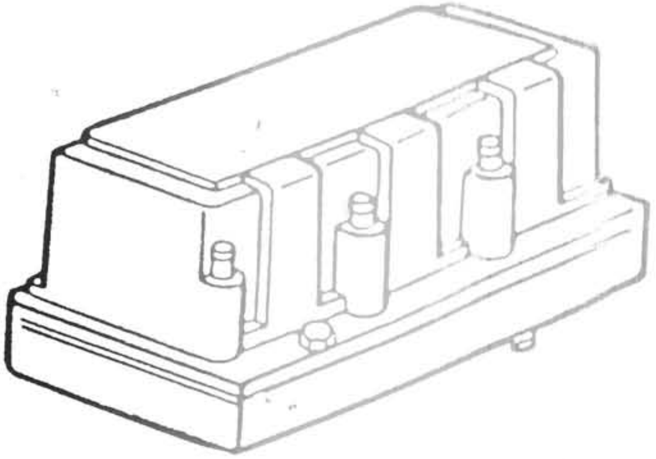
NOTE: If there is an Electronic Spark Timing (EST) failure (which sets code 42), the engine will operate with reduced performance in the bypass mode. When the Distributorless Ignition Adapter is connected, the ECM receives signals from the adapter, so it doesn't see the defective EST. After starting, the ECM will switch out of bypass. Since the module's EST isn't operating, the engine will die when the ECM switches from bypass to EST.

In some of the newer modules, the bypass mode has a well-tailored spark advance curve. You may not even notice that you are operating on bypass instead of EST until the engine dies when you hook up the adapter.

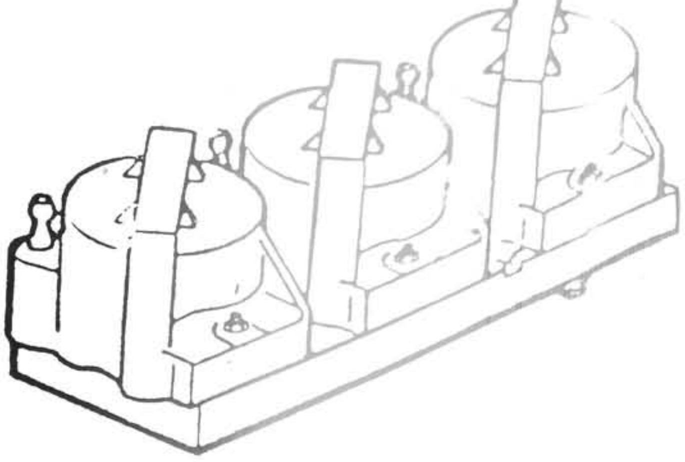
COIL MODULE

The ignition coils are mounted on top of the ignition module.

The TYPE I coil module has 3 spark plug cable terminals on each side. One side leads to the even numbered cylinders, the other side is for the odd numbered cylinders.



The TYPE II coil has all 6 terminals on the same side.



CRANKSHAFT POSITION SENSOR

The Crankshaft Position Sensor is a Hall Effect device mounted to the front of the engine near the harmonic balancer. The balancer has 3 blades which signal when each pair of pistons is at Top Dead Center.

The crank sensor sends a reference signal and a tach signal to the ECM through the ignition module. These signals are processed by the ECM to determine when the spark plug should fire.

If the Crankshaft Position Sensor fails, the engine will not run but there will be no trouble code set.

If the Crankshaft Position Sensor is operating correctly, it will generate a square wave at the center terminal when the engine is running or cranking.

Use the Red Special Probe and the Smart Scope "Self Sweep" function or the Smart Engine Analyzer "Pattern Display" function to determine if you're getting a square-wave signal from the Hall Effect.

The signal is processed in the ignition module and received at ECM terminal B5.

CAMSHAFT POSITION SENSOR
A separate Cam Position Sensor is used only on 3.8L engines. It, too, is a Hall Effect device that is located in the distributor opening or mounted on the timing chain cover. It signals the ECM when the #1 cylinder is on compression.

If the Cam Sensor fails while the engine is running, code 41 is recorded and all the injectors fire simultaneously. The engine cannot restart until it receives a signal from the cam sensor.

This signal is also processed in the ignition module and can be measured at terminal A11 of the ECM.

DUAL CRANK SENSOR
This is used on 3.0L engines only. It has two separate Hall Effect devices and there are 2 sets of vanes on the balancer pulley. There is a 3-slot ring, which operates the same as a standard crank sensor and a 1-slot ring, which replaces the cam sensor. This is not used on Sequential Fuel Injection models, because it provides TDC information only for cylinder pairs.

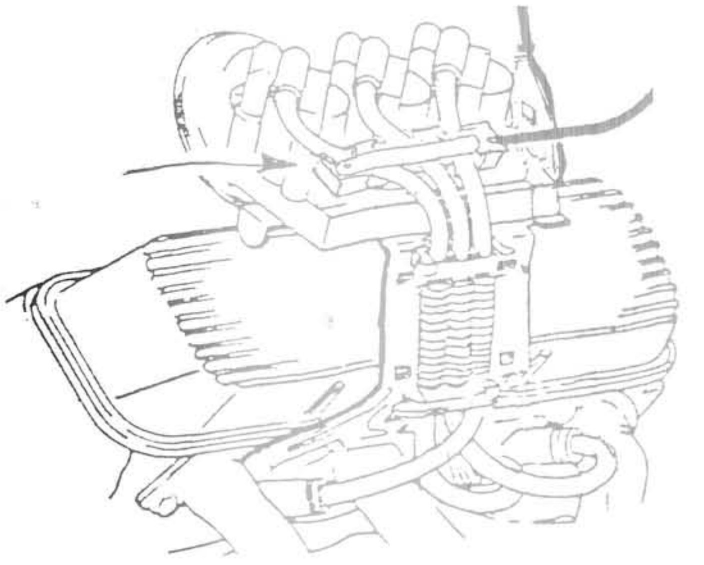
The electrical connctor has four terminals...the center two are cam and crank signals.

UNEVEN SPIKE HEIGHT ON TRANSVERSE C3I ENGINES

Dave MacIlhargey, Detroit

Summary: Voltage induced by the ignition coil pack seems to be cancelling out a signal in the Distributorless Ignition Adapter secondary clip.

Symptoms: alternating high-low kV spikes with C3I ignition on transverse engines. The low spikes are invariably on the firewall side of the coils.



We were trying to locate a problem tha
affected those three cylinders or a
electronic module failure.

Cause: the opposite-polarity voltage
the coil is being picked up by the sec
ondary clip. This cancels out the sign
from the plug wires, which have the op
posite polarity.

Take a look at the spark plug cables b
there. The three wires make a sharp 9
turn, then disappear into a plastic wi
ing harness. When you attach the seco
ary clip, it usually lies right again
the side of the coil/module assembly.

It works just like the HEI/IIA adapter
lay it on top of the coil and it picks
the secondary signal.

Repair: insulate the secondary clip fr
the side of the coils by moving it aw
or inserting a piece of cardboard
foam.

Note: Alternating high-low kV spik
could indicate a problem (see Da
McBride's article). Try this meth
before making any repairs.

SPARK PLUG CRACKING DUE TO ELECTRICAL PRESSURE

Dave McBride, Atlanta

Summary: A common complaint in GM d
tributorless ignition engines is
"Electrical Pressure" crack of the sp

plug porcelain.

This isn't like the cracked insulator you're accustomed to. Instead, when you pull the spark plug, it looks like someone used a magic marker to trace down the side of the porcelain.

Symptoms
Backfire through intake.

Air box reduced to shrapnel.

Peak KV is slightly lower on the affected cylinders.

Cause: I've seen some gorilla-sized mechanics over-torquing the spark plugs. The stress on the porcelain causes hairline cracks. All the power in the coil will blast along inside the boot, right down these cracks, and to ground.

It's easier to arc down to the engine block than fire some of the extremely lean mixtures in certain RPM ranges.

This problem usually occurs on the front side of a transverse engine, because the plugs are easier to reach.

Repair: Replace the spark plugs and tighten to specified torque only.

DON'T listen if the technician insists he has replaced the plugs already. He probably overtorqued the new plugs, too.

You'll be a hero.

DISCONNECTING THE DISTRIBUTORLESS IGNITION ADAPTER FROM THE SMART SCOPE

Steve Juenemann, Service, Kalamazoo

Tell customers to completely remove their 32-370 Distributorless Ignition Adapter before testing non-C3I engines.

If a 32-370 is left attached to the C3I receptacle on the side panel of a Smart Scope, the secondary pattern on any conventional-ignition engine will be shorted down to the OkV line.

If only the cable is left plugged in to the side panel, you'll see a large additional spike in any secondary display.

DISTRIBUTORLESS IGNITION ADAPTER UPDATES

Dave Chamberlain

Let's clear this up once and for all.

General Motors made a running change early in the 1986 model year that was not compatible with the original version of the distributorless ignition adapter. For a short time, you could identify the new units because they had red spark plug wires.

We decided to update all the adapters so they operate on the new ignition system. As of today, the distributorless ignition adapter works on all current DIS/C3I systems.

Allen records now indicate that all the adapters have been updated.

The update consists of new "Local software" inside the adapter box, a "Patent Pending" sticker, a serial number plate and a sticker that says "Update C." There is no change to any of the software in the analyzer.

The customer was also provided with the minimum software required to support the adapter. In the case of the Smart Engine Analyzer, that is level 3. For the Smart Scope, the customer receives Level 10.

Here is the confusing part (for some people): even though the adapter now works on 1986 engines, the SEA will not necessarily work on 1986 vehicle computers (unless the customer purchases Level 4 or newer software).

Some customers believe that they will be able to operate their SEAs on all 1986 computer systems once their adapter is updated. That is not true.

USING THE DISTRIBUTORLESS IGNITION ADAPTER "A" AND "B" CABLES

Dave Chamberlain

This item has caused a frightening amoun of confusion among operators and Allen personnel alike, so I am going to lay this out in words of one syllable.

Under Harness Adapter Applications (p. 2) the book says:

"1984 and '85 3.8L turbocharged (Buick Regal and Riviera) A

"All others with DIS/C3I B

Look, this is simple. This is a complete list. If the car is listed, then use the "A" cable. That means it must be:

1984 or 1985
Buick
turbocharged

ALL THREE!!! Forget about what year the manual was published. Forget about any individual item in the list. The engine must meet all three of these criteria! For instance, what would you do with a 1986 Buick Riviera? Cable "B" of course! It's not 1984 or 1985, and it's not a turbo (turbo is not available in 1986 Rivieras).

How about a 1986 Buick 3.8L turbo? Cable "B"! (it's not an '84 or '85)

Now for the final quiz. You're testing a 1985 Regal with a turbocharged 3.8L V6. Which cable do you use? Cable "A." It matches all three criteria. 1984 or '85, Buick, and turbocharged.

1986 CHEVROLET SPECTRUM: ALL-SYSTEMS TESTING

Frank Newton, Engineering, Kalamazoo

The 1986 Chevrolet Spectrum uses a new Nippondenso Integrated Ignition Assembly (IIA) system similar (but not identical) to the Toyota system.

There are some special procedures required for testing.

You will need a short jumper wire (4-6 inches, 10-15cm) with a U-shaped spade connector or an eyelet with the end ground open. The other end should be bare.

Test Procedure:

1. Remove the distributor cap, rotor, and the the plastic shield marked "Do not remove."
2. Connect the jumper wire to the "-" terminal on the coil. It is clearly marked.
3. Lay the jumper wire on the rubber grommet (used for the distributor electrical connections).
4. Reinstall the protective cover, rotor, and cap.
5. Connect the Green Lead to the exposed end of your jumper wire.
6. Clamp the existing IIA adapter over the cap. It's a little big, so use a big rubber band or string to secure it. Proceed with testing.

Note: Do not allow the jumper wire or green lead to short to ground. Remove the jumper wire when testing is complete. Make several jumper wires. They get pretty beat up by the cap.

SEA MANUAL QUALITY CONTROL

An unknown number of Smart Engine Analyzer Programmed Training Course manuals (P/N 25711-2) were assembled incorrectly. The manuals are appearing in SEA accessory kits and a limited number were shipped through Service Parts. If you have received a defective manual (with large numbers of pages missing or repeated), it can be replaced at no charge by calling Kalamazoo Service Parts Ordering. Make sure you say you are replacing a defective manual.

TRAINING DEPARTMENT SNIGLETS

Chamberitis painful condition that occurs when you call Dave Chamberlain and he tells you the information you need is in a manual you were supposed to read. (John Bailey, Portland).

Idonediditoit Button (n) device that signals the SEA to proceed with testing (Phil Spinolo, Jeff Moore, Memphis)

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his is an index of the first 12 issues of Training Tech Topics (July, 1985 through June 1986). The first number is the issue number, the second is the page number. Therefore, (4, p3) indicates you will find the article in Number 4 (Oct., 1985) on page 3.

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62-000 SERIES SMART ENGINE ANALYZER HELPFUL HINTS

(level 4.0 software)

DAILY START UP

GAS ANALYZER WARM UP

The SEA is ready to perform most tests immediately after "power up," and while the optional 4-Gas Analyzer or EPA Analyzer is completing a required 15-20 minute warm up.

Once the gas bench is warm, the SEA will allow Complete Systems Analysis and Individual—Fuel System tests. Plus, gas values are displayed on the Manual Mode—Fuel System and Measurements—Emission screens.

HOW TO "NETWORK" THE GAS ANALYZER

EPA Analyzer: For full function SEA operation, turn on both units. When the Unit Ready lamp lights (after 15-20 minutes) select Network Mode from the EPA Set-up screen. The EPA screen will go blank to indicate it is ready for testing. To use the EPA Analyzer alone, press **ESCAPE** on the EPA keyboard; this severs communication with the SEA.

4-Gas Analyzer: Turn on both units. The "Unit Ready" and "Communication" lamp will light to indicate the 4-Gas Analyzer is ready for testing.

VACUUM PICKUP

Do not plug either port on the vacuum pickup. This can cause invalid readings—the SEA reads the pressure difference between the two ports. To zero the vacuum pickup, see reference 17-09 in the PTC Supplement (p/n 25766-040).

SCREEN GOES BLANK

If several minutes elapse without test activity, the monitor screen goes blank to prevent image burn-in. Press the remote button to awaken the screen.

LOW FLOW LIGHT

The "Low Flow" lamp goes on and off during an automatic test because the SEA turns the pump on and off. The lamp should be off, to indicate normal flow, when the pump is on. If it lights with the pump running, a sample circuit restriction is indicated. Check the filters, hose and probe.

CRANKING TESTS

BATTERIES THAT FAIL DURING CRANKING

Some batteries may fail to crank the engine for the entire cranking test. If this happens, keep the key at "crank" position until prompted to stop. In a moment the SEA displays "Battery Boost Required," then retests. Within 15 seconds after the engine starts, stop battery boost and raise engine rpm above 2300 for the charging test.

CRANKING TESTS—FUEL INJECTED ENGINES

Perform cranking tests at wide open throttle to activate the "Clear Flood" mode and reduce fuel delivery. Otherwise, cranking enrichment can load up the engine causing detonation (erratic cranking) and hard restart.

CHARGING TESTS

VEHICLES WITH GENERATORS

When testing generator equipped vehicles, disregard any diagnostic result that refers to alternator patterns. Alternator and generator waveforms differ.

IGNITION PRIMARY/DWELL TESTS

GM ODD-FIRING V6

When evaluating Cylinder Time Variations, these engines produce alternating high/low readings. This is normal and does not indicate a problem.

TIMING TESTS

DEFECTIVE VACUUM ADVANCE (ref. 4-05)

Some vehicles deny vacuum advance until high gear. Manually apply vacuum and check advance system response to verify this result.

INITIAL TIMING TOO HIGH—OTHER RESULTS MAY BE AFFECTED (ref. 4-06)

Spark timing directly affects combustion efficiency and should be close to normal to avoid invalid results. Adjust timing and retest.

INSUFFICIENT ADVANCE SYSTEM RESPONSE (ref. 4-10)

For Chrysler feedback systems, use an aquarium air

Eldorado) and K-Body (Cadillac Seville) have a high-speed computer data stream which can be read only with the Tech 1 tester. See your Allen Sales Representative for details.

1985, '86 CHEVROLET SPRINT

These vehicles are made by Suzuki. For proper data entry, select #**Other** on the "Vehicle Make" and "Type of Fuel System" screen.

DISTRIBUTORLESS IGNITION AND CD ADAPTER OPTIONS

The Special Functions screen (0-19) has a bull's-eye labeled "Options." Use this item to activate the software for optional SEA adapters.

Select #**Options**, then select #**DIS/C³I Option**, #**Capacitive Discharge Adapter Option**, or any other option that you own. The activated options will now appear for selection on the "Number of Cylinders" screen (ref. 0-26).

Allen Testproducts

Revised 03-21-86

p/n 25715-040

FOULED PLUG/SHORTED WIRE (ref. 5-08)

GM distributorless engines (DIS/C^{3}I) can set this result if a spark plug wire is disconnected at the coil end. Check the connection before condemning a spark plug or cable.

With an open between the Secondary Clip and Coil, the voltage dissipates across the "waste spark" side of the secondary circuit, the block, and the spark plug of the compression cylinder before its sensed by the Secondary Clip.

POWER ANALYSIS TEST

FULL TIME AIR CONDITIONING (A/C)

Some vehicles run the A/C system at all times. Before running any automatic test, unplug the A/C clutch electrical connector. This stops A/C clutch cycling which changes rpm and affects test results.

CLOSED LOOP (feedback) SYSTEMS

The operator may be directed to disable the closed loop fuel system. There are many methods used to disable the system depending on the make or model. See reference 9-01 in the PTC for details. Failure to disable the system may cause invalid test results.

GM ODD-FIRING V-6

Because of cylinder timing, these engines show an unusual 3 high and 3 low bar graph on the Vacuum Per Cylinder screen. Verify that the 3 high and 3 low bar graphs align.

PERFORMANCE AFFECTED BY VALVE TRAIN/EGR/LEAN MIXTURE (ref. 6-03)

(engines with electronic ignition)

If this result (6-03) is accompanied by "Defective Plug Wire" (ref. 5-06,) verify result 5-06 first.

Especially when the cylinder identified in result 6-03 fires immediately after the one called out by result 5-06, and the vehicle has electronic ignition.

An open plug wire creates an electrical disturbance which can affect the performance of the next cylinder in the firing order.

Substitute a known good plug wire and verify by retesting with an Individual Systems-Secondary/Power Analysis.

FUEL SYSTEMS ANALYSIS

IDLE MIXTURE TOO RICH (ref. 7-05) or MIXTURE TOO RICH—DEFECTIVE CARBURETOR/CALIBRATION (ref. 7-21)

A carburetor that is too rich can mask other problems such as defective spark plugs or plug wires because the richer mixture ignites easier.

If this result appears, make fuel system repairs and perform another Complete Systems Analysis to check for previously hidden faults.

FUEL INJECTION WAVEFORMS (ref. 17-50)

If the SEA shows a "0" reading for Fuel Injection Pulse Width or Frequency (ref. 17-50), the Blue Lead may be hooked to the wrong wire or may have come loose.

After connecting the Blue Lead properly, use the light pen to leave and return to the Fuel Injection display. This resets the signal reading circuit to produce a valid display.

ON-BOARD COMPUTER DIAGNOSTICS

1986 GM E-BODY AND K-BODY CARS

GM E-Body (Olds Toronado, Buick Riviera, Cadillac

1981 CARBURETED GM ENGINES

These vehicles do not report Mixture Control Solenoid Dwell on their "Full Chart" data stream.

1985 AND NEWER FORD EEC IV SYSTEMS

During the Engine-Running Self-Test, press the brake pedal once. If this is not done, some models will generate an On-Demand code 74.

DEAD ENGINE TESTS

VOLTAGE ARCING TO GREEN LEAD

If ignition secondary voltage is arcing to the Green lead the SEA may display "No Secondary Output" (ref. 9-94). Inspect during cranking to verify that secondary voltage is not leaking to the Green lead.

MISCELLANEOUS

NISSAN NAPS-Z ENGINES (without EFI)

These 4-cylinder engines have dual ignition systems that fire together, i.e., 8 spark plugs, 2 coils and 1 distributor. For proper results, test the ignition system that fires the intake manifold side of the engine before testing the exhaust manifold side.

1. Connect the Sync Probe, Green Lead and Secondary Clip to the "Intake Side" ignition system. Disable the "Exhaust Side" coil by removing the primary wire, then perform a Complete Systems Analysis.
2. When complete, print the results. Do not press Reset.
3. Disable the "Intake Side" coil and enable the "Exhaust Side" coil. Then swap the SEA leads to "Exhaust Side."
4. Select #**Individual Systems** , then #**Primary/Dwell** and complete the test.
5. Select #**Individual Systems** , then #**Secondary/Power Analysis** and follow the prompts.
6. Select #**Recall Results** from the Automatic Test Selection screen, then print the results.

ROTARY ENGINES

When testing rotary engines, select the number of Rotors and not the number of rotor lobes. Example: Mazda engines have 2 rotors, so on the "Enter Number of Cylinders" screen (ref. 0-26), select **2** .

CAPACITIVE DISCHARGE (CD) IGNITION (and some Mercedes non-CD ignition systems)

Some CD ignition systems do not generate the proper "tach" signal when the Green Lead is connected to the ignition coil. They cannot be tested with the Complete Systems Analysis without using Allen's CD Adapter (P/N 32-170).

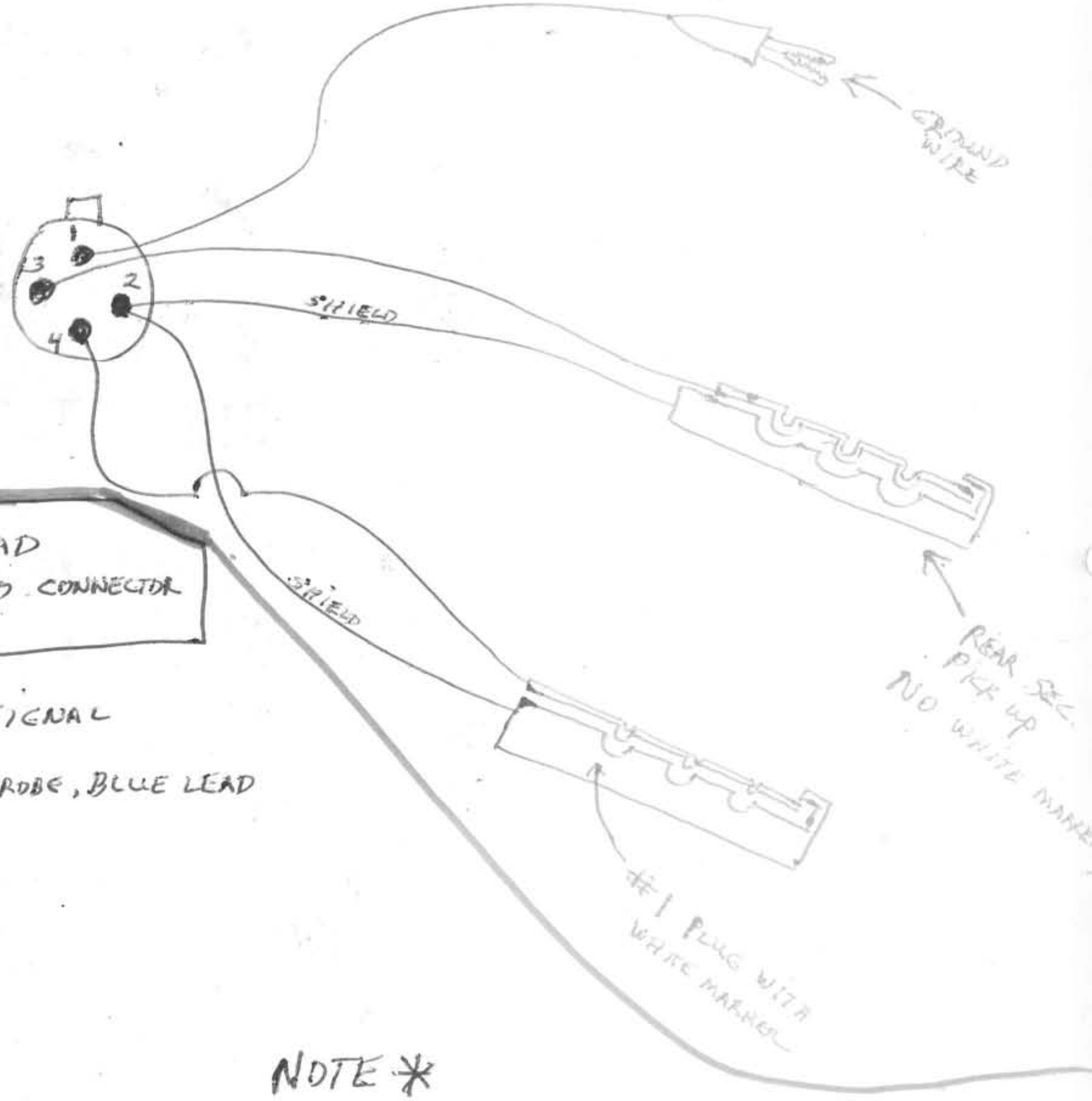
Some non-CD Mercedes ignitions have the coil negative going directly to ground rather than through the ignition module first. These systems require the 32-170 Adapter to disable cylinders in the Cranking and Power Analysis tests.

When testing Mercedes with the 32-170 Adapter, the test result "Inadequate Primary Signal" (ref. 3-13) may appear. Disregard it.

RETESTING INDIVIDUAL ENGINE SYSTEMS AFTER A COMPLETE SYSTEMS ANALYSIS

The SEA has a feature to compensate for operator errors made during a Complete Systems Analysis.

1. Complete the test sequence as usual, but don't press Reset.
2. Select Individual Systems Analysis and repeat the test where the error was made.
3. Select #**Recall Results** . The SEA uses the new data to compute the test results.



C3I - MAIN LEAD FROM SCOPE TO CONNECTOR ON C3I BOX

16 - SEA VERT SIGNAL

15
14 } FUEL IGN PROBE, BLUE LEAD

13 - SS SYNC

12 - +12 VOLTS

11 - NOT USED

10 - NOT USED

9 - KILL SIGNAL

8 - COND. DWELL

7 - NOT USED

6 - CRANK OUTPUT-TACH

5 - SYNC SEA

4 - GROUND

3 - -12 VOLTS

2 - SS VERT. OUTPUT

1 - C3I PRESENT (5 VOLT SIGNAL)

NOTE *

[redacted] THE 5-1036-5 PCBA
WILL NOT WORK ON
"CYL. BAL. WITH GASES"
ON SEA - WORKS OK
ON DEA

KANDEE KYNOIA

ALLEN GROUP TRAINING TECH TOPICS

October, 1986 Number 16

1987 GM SYSTEMS

Dave Chamberlain, Kalamazoo

This is a quick overview of the changes in 1987 GM vehicles and how we're responding to them.

8192 Baud Data Stream

BACKGROUND
Computer data is measured in "bits." One bit is a single ON or OFF signal (0 or 1).

Data transmission speed is measured in bits per second. This is also called "baud." 160 baud is the same as 160 bits per second.

Bits are grouped in "bytes." 1 byte is made up of 8 bits. A Byte is also called ord.

The data stream we have always read on GM carbureted engines is 20 words at 160 baud. The fuel injected engines uses a 25 word data stream communicated at 160 baud. That means:

20 words X 8 bits = 160 bits.

160 bits ÷ 160 baud = 1 second.

A 25-word data stream takes 1.25 seconds (25 X 8 = 200 ÷ 160 = 1.25).

That's how often you see the SEA screen update; once a second on carbureted engines, once every 1-1/4 seconds for FI.

That changes a lot for many 1987 models. They have a 64-word (512 bits) data stream communicated at 8192 baud. That's three times as much information coming out 51 times faster than before.

read these new data streams, you'll ed SEA Level 5 and Smart Scope level 11 software.

SMART ENGINE ANALYZER
Level 5 software is targeted for release in March, 1987. We have chosen this date because of our commitment to developing, testing and verifying our software on production vehicles of all makes.

Level 5 software (Model 12-050) will be sold for $395. Starting today, customers who order a Smart Engine Analyzer can also order a software update at the time of purchase. These customers will be given delivery preference as the new software becomes available.

ATP will also offer a special 1987 GM Update Kit for the SEA. This kit will contain both Level 5 Smart Engine Analyzer software and a modified Distributorless Ignition Adapter (Model 32-370D) to allow complete engine testing and on-board computer diagnostics on all GM vehicles through 1987. This kit (Model 12-060) will be available in March. Estimated cost will be $1390.

In addition, Model 12-070 (for customers with a current 32-370 adapter) will include Level 5 software and a self-addressed mailer. The customer just packs up his 32-370 and sends it to us. We will rebuild and return it. Estimated cost will be $695, post-paid.

SMART SCOPE
An optional update kit (both hardware and software Level 11) will be required for the new 8192 baud GM computer analysis. Availability is estimated for June, 1987.

DIGITAL ENGINE ANALYZER
The DEA won't require any modification for the fast data stream.

For a complete list of the updates neces-

```
              - IGNITION PRIMARY -

                             0
   RPM           KV    RPM-TIME       VACUUM
    0             0        0.0           0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
  1    2    3    4    5    6    7    8
 TIME VARIATION PER CYLINDER IN F.O.
   11:11 AM              2 Apr 1993


            AL'S D&I REPAIR, INC.
               3483 STURGIS RD.
                R.C.S.D. 57702
                   348-1447


.......................... CUSTOMER NAME
.........................YEAR/MAKE/MODEL



             - IGNITION SECONDARY -

                              0
                             RPM

  1    2    3    4    5    6    7    8

                 KV PER CYL

                FIRING TIME



             - IGNITION SECONDARY -

                             0
                            RPM

  1    2    3    4    5    6    7    8
  0    0    0    0    0    0    0    0
SECONDARY ENERGY REQUIREMENTS

 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
FIRING LINE KV

  0    0    0    0    0    0    0    0
FIRING LINE VARIANCE
```

```
 0     0     0     0     0     0     0     0
FIRING LINE VARIANCE
```

NEED VER 9 TO USE O.K DATA PRINTER TO PRINT GRAPHICS

PRINTS ONLY ONE STYLE FRONT PANEL NOT SELECTABLE

```
                 - IGNITION SECONDARY -

                           0
                          RPM

 1     2     3     4     5     6     7     8
 0     0     0     0     0     0     0     0
SECONDARY ENERGY REQUIREMENTS

0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
FIRING LINE KV

 0     0     0     0     0     0     0     0
FIRING LINE VARIANCE
```

SWITCHES

1- OFF
2- OFF ← SLASHED O (ZERO) WHEN ON LIKE
3- OFF
4 - OFF
5- OFF
6- OFF
7- OFF
ON

~~FULL~~

```
                 - IGNITION SECONDARY -

                           0
                          RPM

 1     2     3     4     5     6     7     8
 0     0     0     0     0     0     0     0
SECONDARY ENERGY REQUIREMENTS

0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
FIRING LINE KV

 0     0     0     0     0     0     0     0
FIRING LINE VARIANCE
```

9.1

NEED VER. 8 OR BETTER

Called JOHN FANNING
- TELL ABOUT AL'S D&I NEEDING VER. 8
UPDATE OR BETTER.
~~NEED SEM SER# FOR ADDL BOX~~

NOT THERE

NO VAC WAVE FORMS OR ANY OTHER NOT S.

☐ PRINT WAVEFORM

~~7 PAGES TECH VER.~~

~~7 PAGES CUST VER.~~

~~CRAB SYSTEM~~

CRANKING VOLT TOP JOINT

~~# OF PEAK SPACE~~

ALLEN TEST
THINK "SMART" with ALLEN INSTITUTE
Technical Training BULLETIN

PATTERN PRINTING WITH THE 62-000 SERIES SMART ENGINE ANALYZER

(Reference 19-30)

The **#Print Pattern** capability has been added to the **Smart Engine Analyzer** (SEA) Manual Mode in Version 2.0 and later software. It is a complex tool that can be used to print DC waveforms from any of three input sources. These waveforms are a graphic display of voltage changes over a given time period. This capability is similar to an oscilloscope, but it features a number of adjustments that are usually available only on a sophisticated single trace "lab scope" and not the standard automotive diagnostic scope.

Because the **SEA** does not use conventional dials or knobs, the operator uses the light pen to select the various factors that affect the size and scale of the printout.

THEORY OF OPERATION

The **Smart Engine Analyzer** stores a waveform in a "Pattern Memory" microprocessor, then will print the waveform according to the scale selected by the operator. The horizontal scale represents time and the vertical scale represents voltage. Depending on a number of variables chosen from the screen, the pattern can display Direct Current voltage waveforms from —250 to +250 volts lasting as long as 5½ seconds.

Many electrical circuits change voltage in response to a number of conditions. Trouble codes generated by a vehicle's on-board computer are a square wave of on-off voltage pulses. The pulses happen so slowly that an oscilloscope is not needed. The ignition primary and secondary signals, familiar to people who operate an automotive diagnostic scope, are also varying voltage signals. The rectified AC voltage signal from the alternator appears on a conventional voltmeter as a steady DC voltage. When the operator uses the current probe to print a waveform, though, the rectified AC current is clearly visible, as are any problems with the alternator diodes or stator.

USES

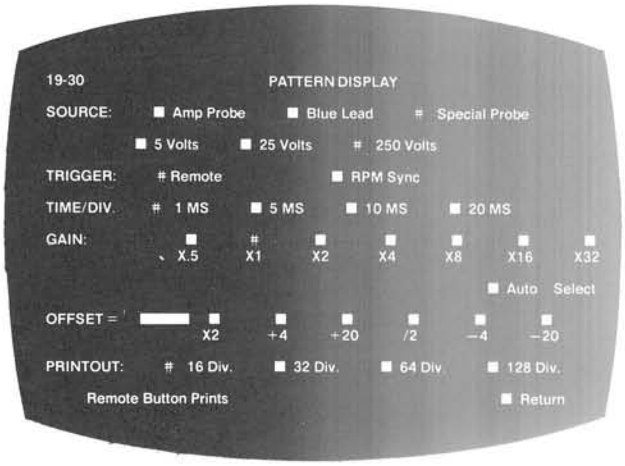
The **Pattern Display** function can be used to read the voltage signals from a number of locations:

- Alternator diode patterns (Current Probe)
- Fuel injectors (Blue Lead)
- Mixture control solenoid
- Mass air flow sensor (Blue Lead or Special Probes)
- Oxygen sensor (Special Probes only)
- Hall-effect switches (Blue Lead or Special Probes)
- Ignition modules (Special Probes)
- Vehicle speed sensors (Special Probes)
- Ignition primary (Special Probes, 250V scale)
- Pickup coils (Special Probes)

When using the blue lead or current probe, make sure that the **SEA** black (ground) lead is attached to a good chassis ground.

ALLEN GROUP
Testproducts Division Kalamazoo, Michigan 49007 • Mississauga, Ontario

GETTING TO KNOW THE "PRINT PATTERN" SCREEN



```
19-30                    PATTERN DISPLAY
SOURCE:      ■ Amp Probe     ■ Blue Lead     #  Special Probe
          ■ 5 Volts     ■ 25 Volts     #  250 Volts
TRIGGER:     # Remote                  ■ RPM Sync
TIME/DIV.    #  1 MS      ■ 5 MS      ■ 10 MS      ■ 20 MS
GAIN:          ■       #       ■       ■       ■       ■       ■
             . X.5     X1      X2      X4      X8      X16     X32
                                                ■ Auto  Select
OFFSET = '  ▬▬▬  ■       ■       ■       ■       ■       ■
                 X2      +4      +20     /2      -4      -20
PRINTOUT:    #  16 Div.    ■ 32 Div.    ■ 64 Div    ■ 128 Div.
   Remote Button Prints                             ■ Return
```

SOURCE: the source used by the **SEA** to generate the waveform.

TRIGGER: determines the moment the **SEA** starts to store the pattern in memory.

TIME/DIV: adjusts the time (horizontal) scale of the printout.

GAIN: adjusts the voltage (vertical) scale of the printout.

#AUTO SELECT: allows the **SEA** to automatically select the Gain and Offset to provide the best resolution.

OFFSET: positions the waveform on the vertical axis of the printout.

PRINTOUT: this selects the number of horizontal (time) divisions on the printout and, therefore, the amount of time that is being sampled.

Remote Button Prints indicates that the waveform will store and print the pattern each time the remote pushbutton is pressed.

#Return: returns to the **Manual Mode** screen.

All of these items are discussed in detail in the next section.

A waveform may be printed only one time. Each time the remote pushbutton is pressed, the pattern memory is cleared, then stores the next waveform.

While the **SEA** is printing waveforms, all other functions are locked out. The operator may press the **Reset** button to abort the printing and return to the Start Up Selection screen. Test results and vehicle data stored in the short term memory will be erased.

OPERATION

By understanding the function of each of the adjustments, it will be easy to make the **Print Pattern** mode a diagnostic instrument. What follows is an explanation of all the adjustments on the screen and how they affect the waveform printout.

The recommended procedure is to first use the light pen to select **#Auto Select,** which allows the **Smart Engine Analyzer**'s microprocessors to determine how to print the waveform with the best resolution. The operator can then decide which adjustments to make to the printout.

SOURCE: the source used by the **SEA** to generate the waveform.

> **#Current Probe:** Use the current probe clamped around any conductor, or use the 10X multiplier. The probe uses the Hall Effect to convert the magnetic field around the conductor to a voltage signal which generates the waveform. The **SEA** black lead must be hooked to the battery negative terminal or chassis ground.
>
> **#Blue Lead:** Use the **SEA** blue closed-loop lead to hook to any voltage source. This can be used with M/C solenoids, fuel injectors and other applications. Make sure the **SEA** black lead is hooked to the battery negative terminal or chassis ground.
>
> **#Special Probe** (preselected): When selected, the operator can also select from the **#5 Volts, #25 Volts** or **#250 Volts** scales, depending on the voltage being measured. Because the special probes have a 7 megohm impedance, they are the only input that should be used for oxygen sensor readings.

TRIGGER: determines the moment the **SEA** begins storing the pattern in memory.

> **#Remote** (preselected): Records the pattern from the time the remote pushbutton is pressed. Use this selection when the waveform is not dependent on engine RPM for synchronization.
>
> **#RPM Sync:** Begins recording the pattern at the time the **SEA** receives the next sync pulse (points open) signal after the remote pushbutton is pressed. This is used when the waveform **does** depend on engine speed for synchron-

ization. For instance, the primary voltage signal, crankshaft or camshaft position sensors or fuel injection waveforms are all dependent on engine speed. The operator presses the remote pushbutton to signal the **SEA** when to start looking for the sync event.

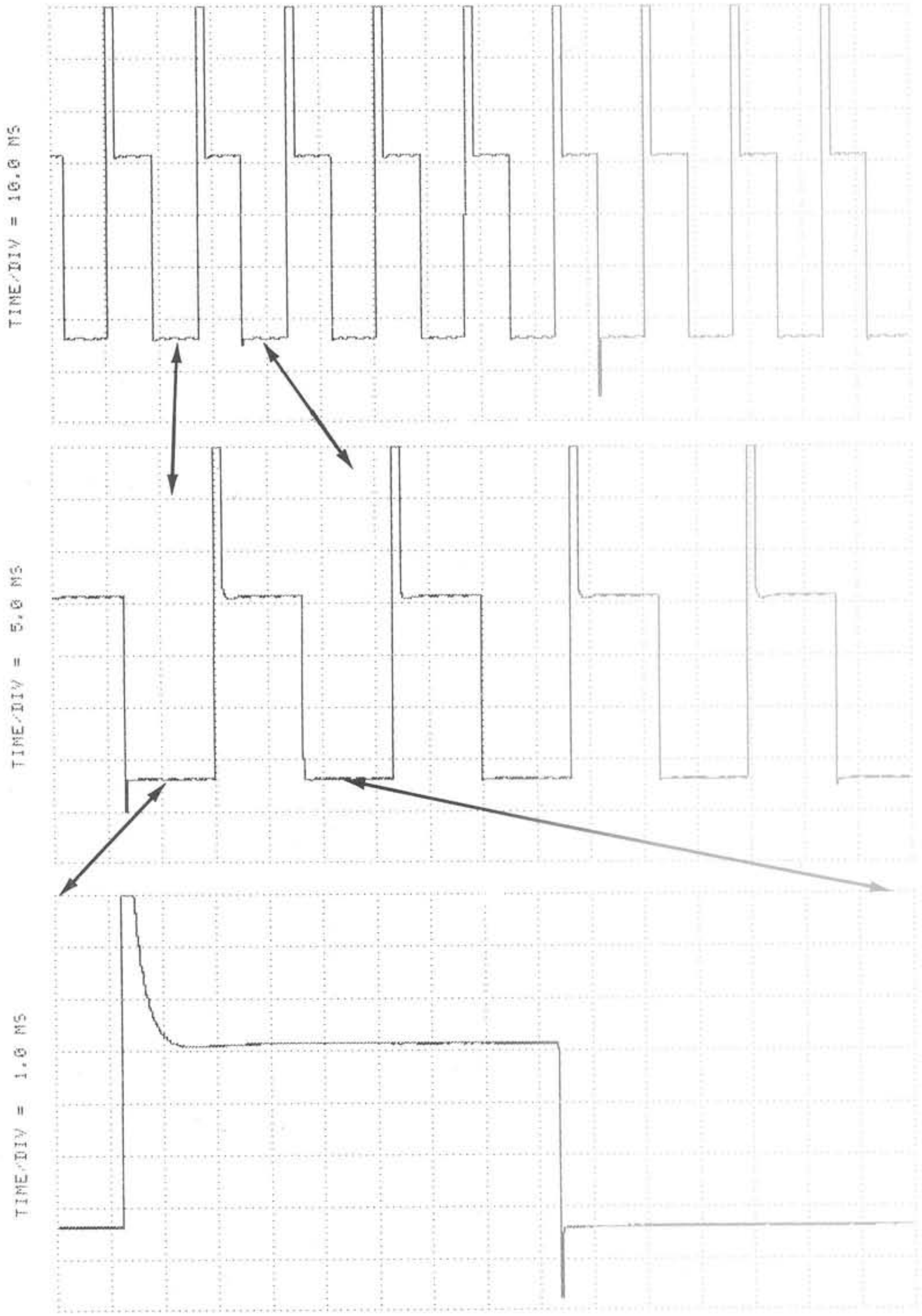
Note: The Sync Probe or the Green Lead must be hooked up for **#RPM Sync** to operate properly.

TIME/DIV: Scales the time (horizontal) scale of the printout.

#1 ms: each division on the printout represents 1 millisecond or .001 seconds (one thousandth of a second).
#5 ms: each division represents 5 milliseconds or .005 seconds (5 times as much data on the same size block).
#10 ms: each division represents 10 milliseconds or .010 seconds (one hundredth of a second).
#20 ms: each division represents 20 milliseconds or .020 seconds (one fiftieth of a second).

Changing the time per division **lengthens** or **shortens** the waveform itself. If the voltage variations happen very quickly, the operator would make each division represent less time, so each fraction of a second can be read individually.

Slow voltage variations (like mixture control solenoid dwell) would use a longer time scale.



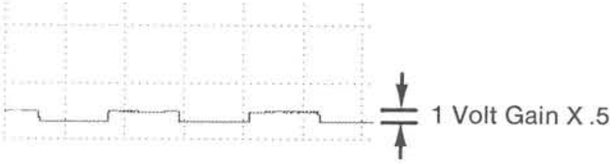
15 ms = 1½ Div.

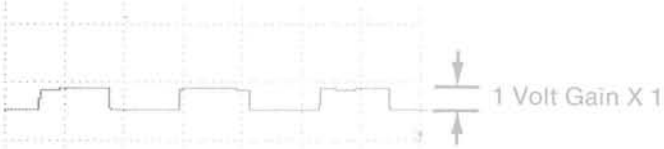
15 ms = 3 Div.

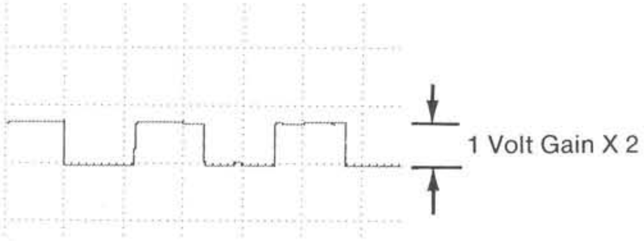
15 ms = 15 Div.

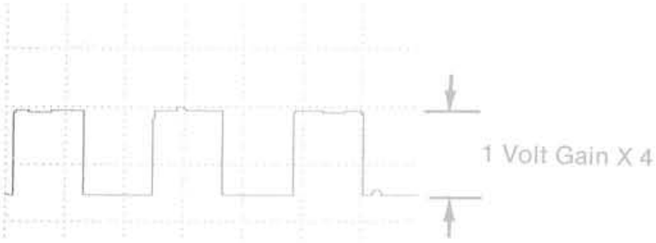
GAIN: Scales the voltage (vertical) scale of the printout. These readings are relative to the voltage being measured and do not represent a specific voltage reading. For example, if each vertical division (voltage) represents 1 volt, selecting **#.5** will make each ½ division represent 1 volt, because the voltage scale is multiplied by .5. When **X32** is selected, 32 divisions represent 1 volt.

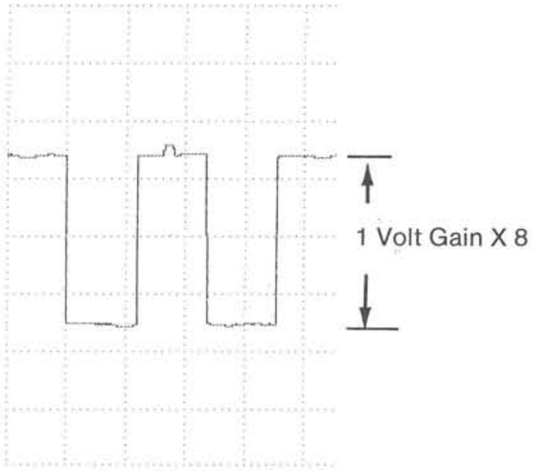
When there are large voltage swings, as in the ignition primary circuit (from 0-250 volts) then the lower **Gain** numbers should be selected. If the voltage variations are small, then increasing the gain increases the resolution available.

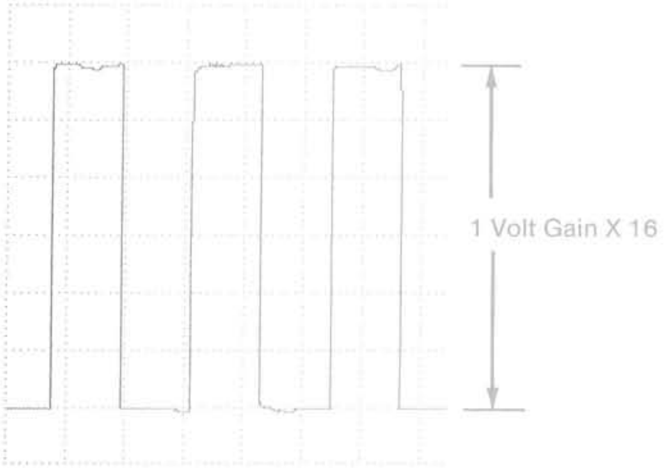


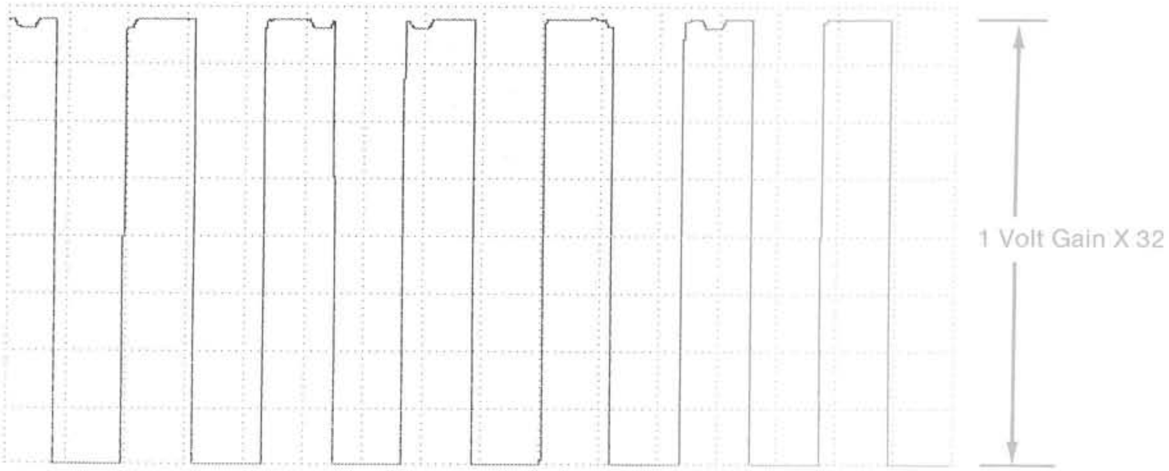












#AUTO SELECT: Allows the **SEA** to sample the signal, then automatically select the Gain and Offset to provide the best resolution. It is recommended that the operator first select **#Auto Select** and print a waveform to determine if he wants to make any further adjustments. For more resolution, or to view a certain portion of the waveform, adjust the Gain and Offset as necessary for the best reading.

#OFFSET: Positions the graph on the vertical axis of the printout. A high Offset number raises the waveform, a low offset number lowers it.

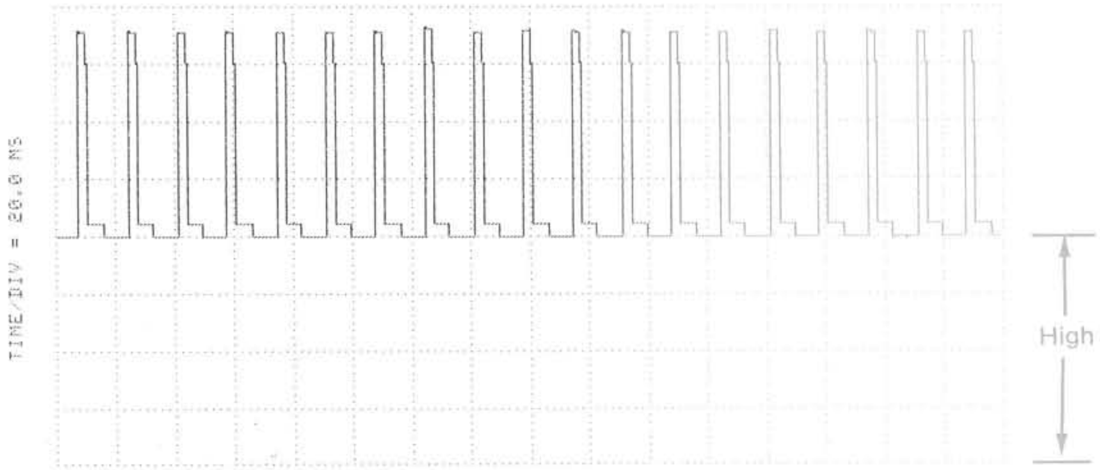
This is useful when one of the other adjustments the operator has selected changes the vertical printing position of the waveform on the printout paper or when the operator wants more resolution in a certain portion of the waveform.

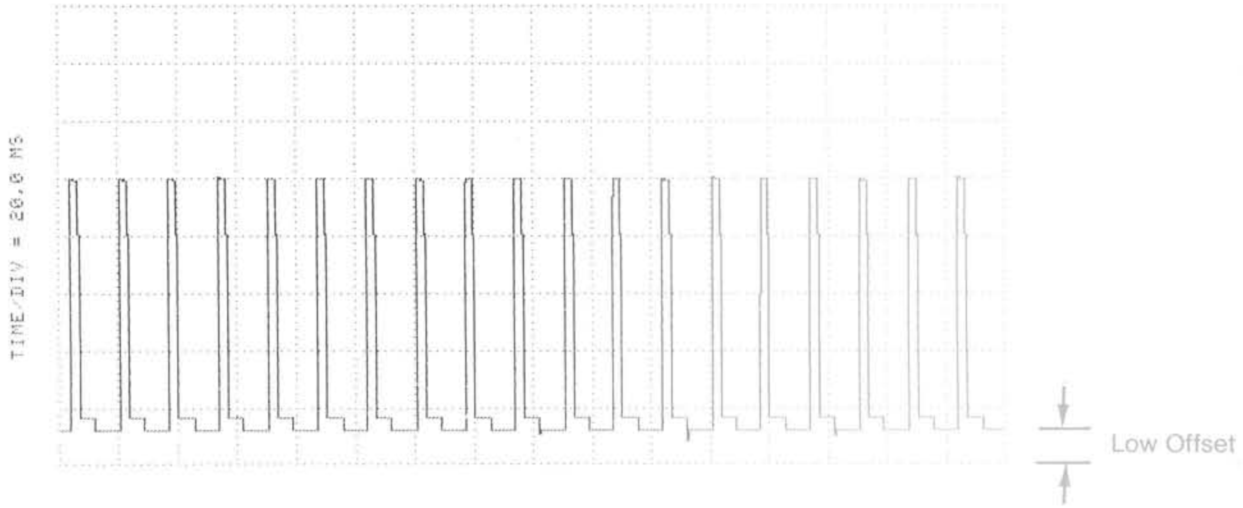
Each bullseye **adjusts** the offset reading in multiples of 4. A reading of **12** is preselected. The range is —508 to +512.

X2 multiplies the reading by 2 (12 x 2 = 14).
+4 adds 4 units to the reading (16 + 4 = 20).
+20 adds 20 units to the offset reading. (44 + 20 = 64).
/2 divides the reading by 2 (12 / 2 = 4)*.
—4 subtracts 4 from the reading (128 — 4 = 124).
—20 subtracts 20 from the offset reading (256 — 20 = 236).

NOTE: Offset is directly affected by Gain. When Gain is higher, changes in Offset have a greater effect.

*12 / 2, of course, = 6. Because this function operates only in multiples of 4, the **SEA** automatically selects the next **lowest** multiple of 4.





#PRINTOUT: This selects the number of horizontal (time) divisions on the printout and, therefore, the amount of time that is being sampled. The amount of time represented in each division is selected in **#Time/Div.**

#16: there are 16 time divisions on the printout
#32: doubles the length of the printout to 32 time divisions.
#64: again doubles the length of time being sampled by the **SEA.**
#128: the greatest number of time divisions that can be selected. This should be selected only for voltage changes that take a long time to be visible. In this mode, the sample time can be as long as 2.56 seconds (when **#20 ms** is selected). It takes over 2 minutes to print the entire waveform.

To determine the amount of time that is actually being sampled, multiply the **#Time/Div.** selection by the number selected in **Printout.**

Examples:

TIME/DIV. X PRINTOUT = length of sample.

1 ms (or .001 seconds) X 16 divisions = .016 second (the shortest sample possible).

5 ms (or .005 seconds) X 32 divisions = .16 second.

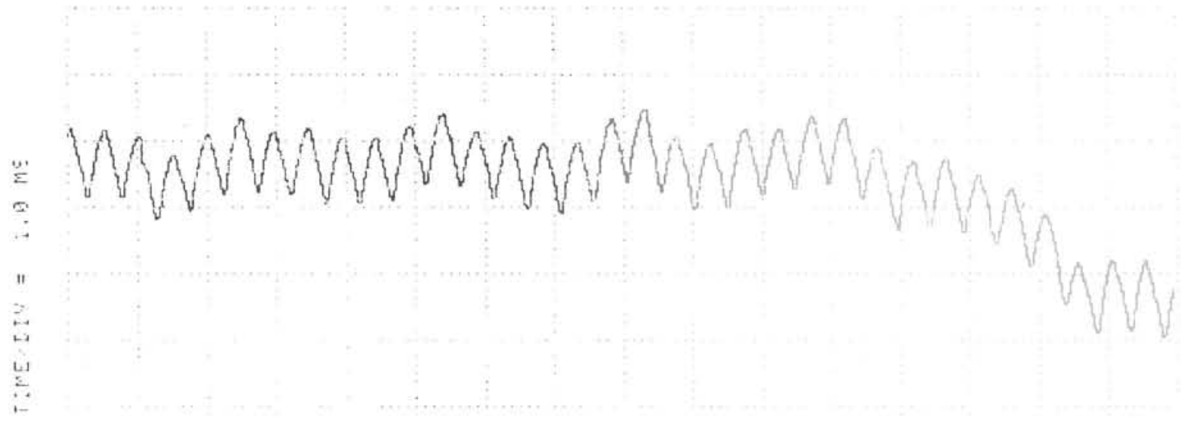
10 ms (.01 seconds) X 64 divisions = .64 second.

20 ms (.02 seconds) X 128 divisions = 2.56 seconds (the longest sample possible).

APPLICATIONS

Alternator Diode Patterns

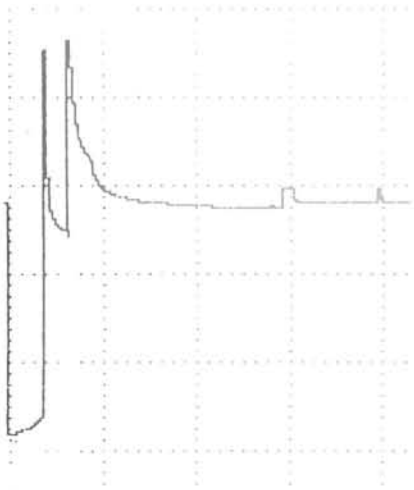
1. Hook the current probe around the alternator charging wire with the probe arrow pointing toward the battery positive (+) terminal.
2. Select **#1 ms/Division.**
3. Select **#Auto Select.**
4. Run the engine. Additional electrical load (turning on headlights, for example) will cause the ripple voltage to be greater.



The pattern should show an even sized ripple with no abrupt dips.

Fuel Injectors

1. Attach the Fuel Injector Adapter (P/N 43437) in series with the injector of back probe the switched injector wire.
2. Hook the Blue Lead to the adapter.
3. Select **#Blue Lead**
4. Select **#RPM Sync**
5. Select **5% ms/Div.**
6. Select **#Auto Select.**
7. Operate the engine normally.



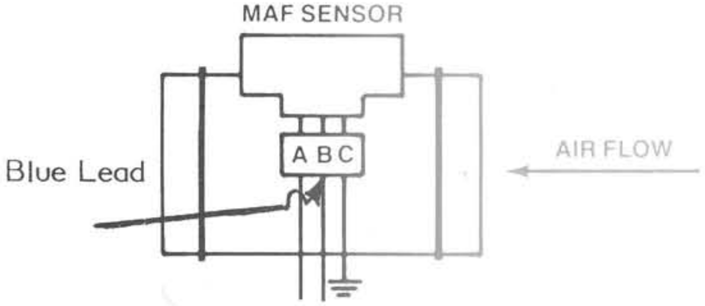
Mixture Control Solenoid

1. Attach the Blue Lead to the M/C solenoid connector or back probe the switched wire.
2. Select **#Blue Lead.**
3. Select **#20 ms/Div.**
4. Select **#Auto Select.**
5. Operate the engine in the closed-loop mode. Enrich or lean out the mixture for a visible indication of the M/C solenoid dwell.

Mass Air Flow Sensor

General Motors L4 and V6 engines use a hot-film Mass Air Flow (MAF) sensor with a signal that varies between 32 and 150 Hz. To verify operation:

1. Attach the Blue Lead to the center MAF terminal as shown in the diagram or back probe terminal B6 at the Electronic Control Module.



2. Select **#Blue Lead.**
3. Select **#10 ms/Div.**
4. Select **#Auto Select.**
5. Print the waveform at several engine RPM settings to verify that the waveform varies at different air flow readings.

Oxygen Sensor

CAUTION: Use **only** the **Special Probe** mode when testing oxygen sensors. Using the Blue lead can cause miscalibration or internal damage to the oxygen sensor.

1. Locate the Oxygen sensor connector under hood or at the Electronic Control Module.
2. Back probe the terminal with the Red lead.
3. Attach the Black special lead to a good chassis ground.

CAUTION: Do not pierce any rubber weather seals when back probing electrical connectors.

4. Select **#Special Probe.**
5. Select **#5 Volts.**
6. Select **20 ms/Div.**
7. Operate the engine in closed loop mode and watch for transitions in the O_2 sensor voltage indicating that the sensor is active.

Hall Effect Switches (cam and crankshaft position sensors, ignition triggers, etc.)
Pickup Coils (ignition triggers)

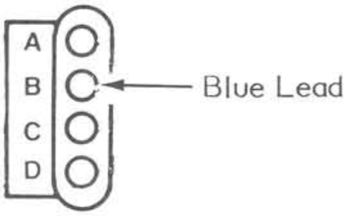
Most Hall Effect switches have three electrical terminals: Power, ground and signal. The signal voltage should have regular, sharp vertical lines indicating the on and off signals.

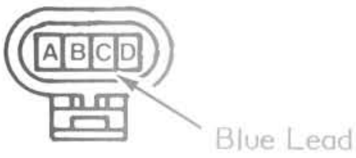
Magnetic switches have 2 terminals. The signal (when observed in the **1 ms/Div.**) mode may not be as crisp as the signal from a Hall Effect switch.

1. Disconnect the trigger connector.
2. Locate the ground wire and insert the Special black lead.
3. Locate the signal wire and insert the Special red lead.
4. Select **#Special Probes.**
5. Select **#5 Volts.**
6. Select **#RPM Trigger.**
7. Select **#10 ms/Div.**
8. Select **#Auto Select.**
9. Crank the engine and press the remote pushbutton while cranking.

GM HEI Reference Signal

Use the following diagrams. Remove the connector and probe the indicated cavity.





Follow the procedures listed in "Hall Effect Switches" above.

Ignition Primary

1. Select **#Special Probes.**
2. Select **#250 Volts.**
3. Select **#5 ms/Div.**
4. Select **#Auto Select**
5. Attach the red lead to the ignition coil distributor terminal.
6. Operate the engine and press the remote pushbutton to print.